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ELECTRICAL ENGINEERING IN THE NAVY.

It would scarcely be appropriate to discuss in these columns whether Secretary Meyer's plan for the reorganization of the Navy Department is a wise one in all or in many of its details, or is merely to be classed with innumerable measures of like kind that in the past have followed the advent of a new secretary ambitious to make a mark as a naval administrator. So far, however, as the Meyer plan relates to changes in the organization of naval electrical engineering work, his recommendations seem to be altogether admirable. In the past the Bureau of Equipment, in addition to equipping vessels with rope, canvas, anchors, cooking stoves, navigation instruments and the like—and unlike—and the purchasing of coal and drinking water, has had cognizance of the design and operation of the electrical plants of naval vessels. Secretary Meyer recommends that this bureau be abolished, and that in the distribution of its work, all matters relating to electric generators and accessories shall be turned over to the Bureau of Steam Engineering. This appears to be not only a logical disposition as relates to the design of electrical installations and purchase of electrical apparatus, but would doubtless also bring to a close the engineering anomaly of having aboard ship separate organizations and personnel for the steam and electrical engineering departments. Moreover, by obviating the apportionment of separate spaces for electrical apparatus in order to emphasize the administrative autonomy of the two engineering departments, space extremely valuable for other purposes would be released.

The Bureau of Construction and Repairs has, it appears, objected to the transfer to the Bureau of Steam Engineering of the electrical department, claiming that this, together with cognizance of rope, canvas, stoves and bunting, should be its inheritance from the defunct bureau. Without questioning the ability of the construction officers to master also electrical engineering in order to be qualified for taking charge of naval electrical work, it seems more rational that all such work ashore should be performed by the officers who will also have charge of the operation of electrical apparatus after installation on board ship. We are not aware of the nature of the present training of officers in the Navy detailed to take charge of the engineering departments of warships, but it would appear that qualification for such duty entails proficiency in mechanical engineering. Assuming this to be the case, it may be pointed out that in the technical schools of this country from 75 per cent to 85 per cent of the studies in the branches of mechanical and electrical engineering are identical. It would, therefore, be a much easier task for an officer trained in mechanical—that is to say, dynamic—engineering to acquire proficiency in electrical engineering than naval constructors whose habits of mind have been formed in the practice of static engineering. Whatever may be the final outcome of the present struggle for ascendency in the Navy Department, we hope that naval electrical engineering will benefit through being finally and permanently assigned by Congressional enactment to the branch of the naval service where it

logically belongs, that is, to the Bureau of Steam Engineering.

HYSTERETIC LOSSES IN IRON AT HIGH-MAGNETIC DENSITIES

An important and interesting report has recently been published in the *Elektrotechnische Zeitschrift*, on a research in magnetic hysteresis, by Prof. J. Herrmann, referred to recently in the Digest. According to opinion based on Ewing's theory of molecular magnetism it has been supposed that when a thin disk of iron was rotated in a fixed magnetic field, or when the disk was held stationary in a rotating magnetic field, magnetic torque and magnetic hysteresis loss might be expected to increase as the flux density increased in the disk, until a certain critical value was attained, beyond which the torque and hysteretic loss might diminish. It has, in fact, been stated by more than one observer that when iron disks were suspended in a rotating magnetic field, the eddy-current losses continued to increase with the flux density; but that after passing about 16 kilogausses the hysteretic torque and hysteretic energy loss fell off rapidly. Experiments to this effect have been published both in England and in Germany. On the other hand, when magnetic flux density was cyclically alternated in iron, the hysteretic loss has been admittedly greater as the flux density increased. In other words, no limit was either expected or reported to the increase in hysteretic loss accompanying increasing alternating magnetic flux densities, although such a limit had been reported in the case of rotating magnetic flux density.

It is a noteworthy fact that the limit of rotating flux density beyond which hysteretic losses are supposed to decline is fairly high, something over 16 kilogausses, and that it is not usual to develop such a flux density in rotating armature cores. If the critical flux density had been lower, say 8 kilogausses, then it would follow that, at constant speed, the hysteretic core loss of a dynamo armature would increase, say, as the 1.6th power of the flux density until 8 kilogausses was reached, and then the hysteretic loss would diminish. Such a result would certainly be easy to observe in factory tests of dynamo machinery. There appears to be no record, however, of any such effect having ever been observed in any factory at any flux density. Whenever the flux density increased the core losses went up distinctly. Nevertheless, those who held to the critical rotative magnetic density in hysteresis loss defended their position by maintaining that 16 kilogausses was very rarely exceeded in armature cores. The factory men always said that 16 kilogausses must have been passed in particular machines, under special tests, without bringing down the hysteretic loss. The laboratory men always said that the limit only seemed to have been passed. Moreover, they said that the falling off would not be very marked until densities of over 20 kilogausses had been passed. Of course, such high densities were very rare. In the case of alternating-current apparatus and non-rotating magnetic fields no dispute could occur.

In the research lately reported by Professor Herrmann thin iron disks were rotated in a magnetic field and the losses were determined thermometrically by the temperature elevation of the disks. The flux densities were pushed up to 27 kilogausses, but no diminution was found either in the eddy-current losses or in the hysteretic losses. Both losses continued to rise rapidly as the flux density was increased to that value. The same observer alleges that in another series of experiments, already published, no appreciable difference could be detected in the magnetic behavior of iron subjected to cyclically varying flux density, whether that flux density was rotated or merely alternated. We are thus brought to a distinct issue of fact in this matter. Several experimenters have reported finding the rotating hysteretic losses diminish beyond a critical flux density. These new results contradict the previous reports. There remains a conflict of testimony. The matter should not be allowed long to remain in the present uncertainty. It should be investigated again, not by a single observer only, but by several independently, the details of the experiments being guarded and reported with care, until a final decision can be arrived at in the matter. From a dynamo standpoint, the question is not of great practical importance, since, from what is already known, it would not be advantageous to push flux densities higher in rotating iron cases in the hope of diminishing hysteretic losses. But from the standpoint of magnetics, it is very important that so simple a question should be answered definitely and without delay. An inference to be drawn from the present controversy is that too much care cannot be taken in measurements of any kind lest the results and deductions be completely upset by subsequent observations. It is better to build more slowly, in order to be sure of the foundations. Fortunately, it is very seldom, in physics, that such conflicts of opinion and testimony arise. In the great majority of instances each unit of discovery and deduction goes into its place in the structure of physical knowledge as a permanent integral portion of the whole. Occasionally, we expect minor modifications to occur in our opinions and beliefs, but a reversal very seldom.

RADIATION FROM METALS.

The subject of radiation is very complex from the quantitative standpoint. Every particle of every material substance with which we are acquainted in the universe about us is generating alternating currents of very high frequency. These high-frequency currents radiate energy, in the form of electromagnetic waves, into all surrounding space. In any piece of matter that we can see or handle there must be billions of wireless-telegraph generators, all jumbled together, each sending out a stream of wireless waves. This phenomenon we call radiation. Energy is absorbed from the substance by the process, and is discharged as alternating-current energy, half electric and half magnetic, into the surrounding ether. The frequencies of these alternating currents range from unknown low limits up to the millions of millions per second. It seems probable that one and the same minute electric generator—the ion—according to the corpuscular theory, is either constantly changing its frequency between wide limits, or is emitting simultaneously a combination of varying frequencies. Up to the frequency of about four hundred millions of millions per second the wireless waves go off unperceived by our senses, except by the sense of heat. In the octave between 400 and 800 millions of millions per second, the waves stimulate in our eyes the sense of light. When the frequency rises beyond this limit, the waves again become invisible as ultraviolet light.

Manifestly such a conception of heterogenous activity as that above outlined does not lend itself to any very simple arithmetical theory concerning radiation. Nevertheless, one simple law has already been discovered, namely, the Stefan-Boltzmann law, that the power radiated electromagnetically by a black body

varies as the fourth power of its absolute temperature. A black body is one whose surface is incapable of reflecting electromagnetic waves of any frequency. It absorbs every wave completely. A filament of ordinary carbon is substantially a black body, and, if we double its absolute temperature, we increase the electromagnetic wave radiation 1500 per cent, whether the waves, or any of them, are within the range of visible frequencies. There are one or two other accepted laws of that wireless telegraphy of atoms which we call radiation. One of these is the law of Wien, as modified slightly by Planck, which expresses the power radiated, at any particular frequency, as an exponential function of the temperature of the body, if the body is a black body. Assuming that the Wien-Planck law of radiation is true for a black body, the question is, what is the corresponding law for a body that is not black? The vast majority of bodies that we know of are not black. They are colored, and in order to have color, in the physical as distinguished from the ethnological world, a body must reflect light, and so cannot be black. Metals are the substances that interest us most, and at ordinary temperatures these are certainly not black bodies. They all reflect light and often reflect some particular frequencies of light preferentially. If they act as colored bodies at ordinary temperatures, we may be prepared to find that they act as colored, or non-black, bodies at incandescent temperatures, and they do.

The article by Dr. Edward P. Hyde, which we publish this week on this question, discusses the experimentally observed behavior of metallic filaments at incandescent temperatures, with a view to ascertaining whether any simple modification of the numerical constants in the Wien-Planck law will make that law apply to a metal, instead of to a black body like a carbon filament. The conclusion arrived at in the article is that, at least, the Wien law cannot be modified in regard to the magnitude of its principal numerical constant, so as to include the metals investigated. It remains open to further inquiry, however, whether the Planck law can be brought to apply from black bodies to metals. These questions are not only of great theoretical importance, but they are also of great practical potential value. Thus, it is now known that a considerable part of the superiority of the tungsten over the carbon incandescent lamp is because tungsten is not a black body, but, for a given temperature, emits wireless waves with greater facility than carbon in the visible spectrum.

TRANSMISSION-LINE EQUATIONS.

With steadily rising line voltages, and steadily increasing distances of transmission, energy-transmission engineers continue to encounter problems of distributed electric capacity more frequently. With an alternating-current line a few kilometers in length, worked at a pressure of a few kilovolts, only the line resistance and inductive reactance need to be taken into account. When the line is many kilometers in length, the effects of capacity become noticeable, and call for recognition by the engineer. The capacity-charging current at the generator end of the line becomes a significant portion of the total working current. A satisfactory solution of the problem can be reached in such cases either by conceiving all the capacity lumped into an imaginary condenser connected at the middle of the line, or by splitting this condenser into halves, and connecting one-half to each end of the line. When, however, the line extends to hundreds of kilometers, and the pressure rises to perhaps 100 kilovolts, the question begins to rise in the mind of the engineer how far the actual condition of uniformly distributed capacity may cause the deductions from a middle-line condenser, or a split-condenser, to fall into error?

Dr. Steinmetz publishes an article in this week's issue on some transmission-line formulas given by Mr. J. F. H. Douglas in our issue of April 28, 1910. In the case of a short alternating-current aerial transmission line, say a line 10 miles long operated at a pressure of 3000 volts, it is sufficient, for ordinary purposes, to treat the line as a choking coil with a resistance equal to the total line resistance and an inductance equal to the total line inductance. The effects of capacity may be disregarded with perfect equanimity from the engineering standpoint. When, however, the aerial transmission line is, say, 60 miles long, and is operated at, say, 40 kilovolts, the effects of capacity can no longer be ignored. The same would be true of a subterranean cable, say 10 miles long operated at 20 kilovolts. In either case, there is a very appreciable charging current that, like Banquo's ghost, insists upon being recognized, and taking the time of the operator. However, all that the transmission engineer needs to do, in order to take care of the capacity, and appease Banquo's spirit, is to insert a condenser at each end of the induction coil representing the transmission line, such that the two condensers are equal and their sum is the total line capacity. This is the split-condenser method of treating the line arithmetically. Finally, if the line is very long, say 200 miles in length, the question arises whether it is proper to lump all its capacity into two end-condensers, or whether it may not be necessary to deal with the line by formulas that take into account the uniform distribution of capacity.

It has been demonstrated on various occasions that, arithmetically speaking, there is no need to mistrust the split-condenser method of calculation for all lengths of line likely to be built for the present so long as we confine ourselves to a fundamental working frequency of 60 cycles per second, or less. The error involved by the lumpiness of the condenser is ordinarily beneath the notice of the engineer. Nevertheless, Banquo is apt to walk abroad at night, and to suggest to the engineer that much error is perhaps involved in the split-condenser formulas. Consequently, the engineer likes to have formulas at hand for use by which the split-condenser results can be checked. The fundamental formulas are those of hyperbolic trigonometry, the name of which is more repellant than the thing named. In his article of April 28, Mr. Douglas showed that the hyperbolic sines, cosines and tangents are easily approximated to, by series of only a few terms, for transmission line purposes. The method he described is undoubtedly simple and practical. It is not, however, new. Almost identically the same method is developed at considerable length near the end of Vol. 2 of Herzog and Feldmann's *Berechnung Elektrischer Leitungsnetze*, published in 1905. Dr. Steinmetz shows very clearly that the degree of precision attained by the approximate formulas of Herzog, Feldmann and Douglas is amply sufficient for engineering purposes over "any economically feasible constant-potential transmission line." It must, of course, be remembered that for higher frequencies, such as are used in telephony, the series approximations to the hyperbolic functions are ordinarily useless, being hopelessly in error, unless a large number of terms in the series are included.

Westinghouse Annual Report.

The annual report of the Westinghouse Electric & Manufacturing Company for the year ended March 31, 1910, has been issued in printed form, for presentation at the annual meeting of the stockholders on July 27, 1910. The report includes the operations of the Westinghouse Lamp Company, the Perkins Electric Switch Manufacturing Company, the Bryant Electric Company and the R. D. Nuttall Company. In submitting the report, Mr. Robert Mather, chairman of the board of directors, said that when the quarter ended Sept. 30, 1910, the payment of dividends was resumed at the rate of 7 per cent per annum on the preferred capital stock, and there was also paid 3½ per cent on account of the deferred dividends on the preferred stock which had been unpaid since Sept. 30, 1907.

The surplus has been reduced by writing off for depreciation of investments in various European Westinghouse companies the sum of $5,723,251. The chairman states that as the result of his first examination into the affairs of the European companies during March and April, 1909, he recommended that the depreciation in the value of these investments be written into the accounts for the fiscal year ended March 31, 1909, but action on the recommendation was then deferred; a further study of the conditions of the European companies, however, has resulted in writing down these items to the extent noted.

The gross earnings for the year ended March 31, 1910, were $29,248,682; the net manufacturing profits were $3,552,978; other income aggregated $1,616,561, making a total income of $5,169,539, or an increase of $3,203,280 over the preceding year. After making deductions the net income for the year was $3,060,664, an increase of $3,979,346 over the preceding year. The value of unfilled orders on March 31, 1910, was, in round numbers, $11,256,000, which is the largest in the history of the company with the exception of the year ended March 31, 1907. During April and May of the present year additional orders were taken aggregating in value $7,083,000, and unfilled orders on May 31 aggregated over $13,000,000.

Since the close of the fiscal year $2,000,000 of treasury funds have been appropriated toward the payment of that amount of the $6,000,000 notes maturing Aug. 1, 1910, and arrangements have been completed for the extension of the remaining $4,000,000 of these notes for a further period of three years. By the above payment the funded debt of the company has been reduced since the receivership by $3,626,000, and the fixed annual interest charges thereby reduced by more than $200,000.

Chairman Mather states that the satisfactory results reflected in the report are largely due to the policy adopted by the board of liberal expenditures for increasing the effectiveness of the selling organization and for development and improvement in design and in manufacturing methods. While this plan has added considerably to the expenses for the year, the increase is stated to have been amply justified both in the increased volume of business and in the decreased cost of production. A number of important lines of the company's product have been so improved by recent development and redesign as not only to decrease the cost of manufacture, but largely to increase the manufacturing capacity of the works, thus enabling the company to maintain and improve its position in the growing market for electrical machinery. Considerable expenditures have been made in adding to the equipment of the East Pittsburgh works, and special mention is made of additions to the testing facilities, which have shown beneficial results in the inspection and testing of completed apparatus.

The increase of business during the fiscal year of the several subsidiary companies above mentioned has also demanded an increase in their facilities. This has been provided for in the case of the Westinghouse Lamp Company by equipping its New York factory, West Twenty-third Street, which has been closed since July, 1908, with complete modern machinery and facilities for the manufacture of 10,000 tungsten lamps per day. These additional facilities it is expected will be ready for use during August of this year. A new building now nearing completion will add approximately 22 per cent to the floor space of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, and consideration is being given to plans for increasing the manufacturing facilities of the R. D. Nuttall Company.

The consolidated balance sheet shows total assets of $83,588,000. Of this sum $14,974,000 is represented by property and factory plant; $13,893,000 in working and trading assets, including raw material and supplies, finished parts and machines, work in progress, goods on consignment and apparatus with customers; $27,206,000 by investments in stocks, bonds, debentures and collateral trust notes, including those of affiliated European and Canadian Westinghouse companies; $20,479,000 by current assets, including $7,040,000 in cash, $3,766,000 in notes receivable and $9,169,000 in accounts receivable. Charters, franchises, patents, insurance, taxes paid in advance, etc., enter in the assets for the sum of $6,083,000.

The main charges under liabilities are capital stock, $40,719,000; funded debt, $22,326,000; collateral notes, $8,720,000; readjustment notes, $1,387,000; current liabilities, $3,302,000; reserve, $1,280,000; surplus, $5,668,000.

As previously stated, the gross earnings for the year ended March 31, 1910, were $29,248,682, leaving a net manufacturing profit of $3,552,978. Other income included interest and discount, $388,539; dividends and interest on stocks and bonds owned, $478,810; miscellaneous, including royalties, etc., $749,211, the aggregate being $1,616,561, thus bringing the total income up to $5,169,539. Deductions amounting to $2,108,875 were made from this amount, the principal items being interest on bonds and debentures, $1,112,320; interest on collateral notes, $496,000; property and plant depreciations, $243,522.

Investigation of Wireless Business.

The Federal Grand Jury has begun an investigation in New York City into the affairs of the United Wireless Telegraph Company, three of the officers of which were arrested and released on bail. They are charged with sending out literature designed to mislead the public in regard to the concern's stock and capitalization. The post office authorities assert that the officers conducted one of the "most gigantic schemes to defraud investors that has ever been unearthed in this country." It is alleged that the company was formed for the purpose of selling worthless stock; that its claim of possessing more than $14,000,000 worth of assets is wholly false, and that the stock has steadily decreased in value because the business has been a losing one. Altogether there are about 28,000 stockholders, scattered principally through the West. According to the Post Office authorities, these stockholders stand to lose upward of $20,000,000.

The president of the company claims that it has a fully paid-up capital of $100,000, and for the last three years has carried an average daily balance of more than $100,000. He states that "The company has equipped 310 ships plying the waters of the Atlantic and Pacific Oceans and the Great Lakes with its system of wireless telegraphy. These ships are in actual daily operation and communicate with the company's 100 land stations, which are also in daily operation."

A. I. E. E. Convention.

The annual convention of the American Institute of Electrical Engineers, which was to have been held on June 27 to 30, has been postponed one day and will be held on June 28 to July 1, at Hotel Waumbek, Jefferson, N. H. The final program for the meetings, which will be held on Tuesday afternoon, Wednesday morning, Wednesday evening and Friday morning, contains 20 items, four papers having been added since the preparation of the preliminary program, which was given in our issue for June 2.

Following the presentation of the presidential address by Mr. Lewis B. Stillwell, the Standards Committee will offer certain standardization rules for approval. The following three papers will then be presented under the auspices of the electric lighting

committee: "Head-Lamp Tests," by Messrs. C. F. Harding and A. N. Topping; "Carbon Filament Lamps as Photometric Standards," by Messrs. E. B. Rosa and G. W. Middlekauff; and "The Modern Oil Switch with Special Reference to Systems of Moderate Voltage and Large Ampere Rating," by Mr. A. R. Cheyney.

Under the auspices of the high-tension transmission committee, seven papers will be read and discussed, as follows: "Disruptive Strength with Transient Voltages," by Messrs. J. L. R. Hayden and C. P. Steinmetz; "The Electric Strength of Air," by Prof. J. B. Whitehead; "Dielectric Strength of Oil," by Mr. H. W. Tobey; "Vector Power in Alternating-Current Circuits," by Dr. A. E. Kennelly; "Determination of Transformer Regulation under Load Conditions and Some Resulting Investigations," by Prof. Adolph Shane; "Observations of Harmonics in Current and Voltage Wave-Shapes of Transformers," by Mr. J. J. Frank; "Parallel Operation of Three-Phase Generators with Their Neutrals Interconnected," by Mr. G. I. Rhodes.

Two papers will be presented under the auspices of the telegraphy and telephony committee, namely: "The History and Practice of Telegraph Engineering in America," by Messrs. William Maver and Donald McNicol; "Telephone Engineering Around the Golden Gate," by Mr. A. B. Smith. A paper on "Interaction of Flywheels and Induction Motors when Driving Roll Trains," by Mr. F. G. Gasche, will be presented under the auspices of the industrial power committee. A paper entitled "Recent Progress in Exact Alternating-Current Measurements" will be presented by Messrs. C. H. Sharp and W. W. Crawford.

The session on Friday morning will be devoted to the reading and discussing of papers presented under the auspices of the railway committee, as follows: "Electric Locomotive Design," by Messrs. N. W. Storer and G. M. Eaton; "A Method of Determining the Adequacy of an Electric Railway System," by Mr. R. W. Harris; "Coasting-Clock Tests on the Manhattan Elevated Railway," by Mr. C. J. Hopkins.

On Thursday evening there will be a dinner and discussion by the sections committee and section delegates. On Friday there will be a dinner followed by a discussion by the educational committee.

Among the entertainment features will be a dance and reception on Tuesday evening at the Waumbeck, and a trip to Mount Washington, which will require practically the whole of Thursday. Special entertainment will be provided for the ladies during the hours of the various meetings.

Special summer excursion and circular tour rates to White Mountain points will be available by June 27 on practically all transportation lines. In addition to several day trains from each place, night trains will leave New York at 9 o'clock and Boston at 8:30 o'clock, arriving at Jefferson at 8:55 a. m.

Proposed Boston Engineers' Headquarters.

A project is well under way for the construction of a combined club, society headquarters and office building, in Boston, in many respects similar to the Engineering Societies Building and Engineers' Club in New York. The following technical societies have appointed representatives upon a joint committee to further the project:

Boston Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Architects (Boston Chapter), Illuminating Engineering Society (New England Section), National Electric Light Association (New England Section), New England Association of Gas Engineers, New England Street Railway Club, New England Water-Works Association, American Chemical Society (Northeastern Section), Society of Chemical Industry (New England Section), Telephone Society of New England and New England Railroad Club.

It is believed that by having a club and various professional and allied societies under one roof each will help the other. The club will make the offices and rooms in the society building more desirable. The occupants of the society rooms and offices will make the business of the club constant and profitable. The proposition requires the formation of a club of 1000 resident members from the engineering, architectural, scientific and artistic professions, as well as commercial allied interests, who will pay an initiation fee of $50 and annual dues of $50, and 500 non-resident members at one-half of these amounts. Prof. I. N. Hollis, of Harvard, is chairman of a committee having charge of details; among the members of the committee are Messrs. Charles L. Edgar, Russell Robb and J. S. Codman.

Convention of Railway Telegraph Superintendents at Los Angeles.

The Association of Railway Telegraph Superintendents is holding its twenty-ninth annual convention at the Hotel Alexandria, Los Angeles, during the present week, the dates being June 20 to 24 inclusive. Mr. I. T. Dyer, superintendent of telegraph for the San Pedro, Los Angeles & Salt Lake Railroad, who is the first vice-president of the association, is presiding in the absence of President John L. Davis. The program of the convention embraces the following papers: "Wireless Telegraphy," by Mr. William Maver, Jr.; "Education for Efficient Railroad Service," by Mr. D. C. Buell, Union Pacific; "Protecting Telephone Lines from Lightning and Other Disturbances," by Mr. M. E. Launbranch, United States Electric Company; "Automatic Block and Highway Crossing Signaling," by Mr. H. P. Ryner, Hoeschen Signal Company; "Telephone Train Dispatching," by Mr. E. E. Dildine, Northern Pacific; "Testing of Telegraph and Telephone Circuits," by Mr. V. E. Kissinger, Chicago, Burlington & Quincy; "Telephoning to and from Trains," by Mr. E. P. Griffith, Erie Railroad. The program also provides for a number of entertainments and social features.

Central-Station Census Statistics.

The Census Bureau has issued a third and fourth bulletin giving further information relating to the 1907 census of central stations. The complete report has not yet been issued.

The commercial and municipal central electric light and power stations in the United States in 1907 numbered 4714; reported $1,096,913,622 as the cost of construction and equipment; earned $175,642,338, of which $169,614,691 was for electric service, including $125,755,114 for lighting; expended $106,205,149; employed 12,990 salaried officials and clerks, who were paid $11,733,787, and also 34,642 wage-earners, who received $23,686,537; operated 10,150 primary-power machines, with 4,032,365 hp capacity; had 12,173 dynamos, with a kilowatt capacity of 2,709,225; and their output, in kw-hours, was 5,862,276,737. Of the total number of lamps wired for service, there were: Arcs, 555,713; incandescent, 41,445,997; and other varieties, 162,338.

THE CLASSES OF STATIONS.

The percentages of increase in 1907, as against 1902, the date of the last census of this kind, are 30.2 in the total number of stations; 117.3 in the cost of construction and equipment; 104.9 in gross income; 91.5 in total expenses; 35.6 in the number of primary-power machines and 120.3 in their total horse-power capacity; 123.5 in kilowatt capacity of dynamos; 201.7 in kilowatt capacity of the alternating single-phase and polyphase current dynamos; 133.8 in the output of stations; 44.1 in the number of arc lamps; and 127.8 in the number of incandescents.

One of the distinctive features of the report is the statement that nearly three-fourths of the stations reported at each census were operated by incorporated companies. Individual ownership was next in importance, the number of stations being less than one-fifth of the total at each census. Firms showed but little proportionate change at both censuses.

A comparison of the totals for the "purely electric" and "composite" central electric stations shows that in 1907 about

three-fifths of the income and cost of construction and equipment was connected with the former and two-fifths with the latter.

Nearly two-thirds of the commercial central stations were reported as "purely electric," and something more than one-third as "composite," and the proportions represent their respective importance. Nearly four-fifths of those in the "composite" group are commercial stations.

It is said to be noteworthy that both the commercial and the municipal stations share in the uniformly large percentage of increase for the "composite" stations, which appears to indicate that the distinctive characteristics of the two principal classes of stations are much less marked than formerly.

WESTERN DIVISION'S SHOWING.

The report states that the increase of single-phase or polyphase plants, referred to in the report for 1902, has continued since that census until, at the census of 1907, the kilowatt capacity of this class of machines represented 82 per cent of the total dynamo capacity of all central stations. In many instances large plants are now located at places where water-power is available for the generation of the energy, but at great distances from where the energy is used.

Statistics relative to 34 selected cities are presented in the report. These 34 cities had 75 stations in 1907 and 70 in 1902, the character of ownership of which, in 1907, was as follows: Corporate, 61; and municipal, 14. In 1902, 58 were corporate; 11, municipal; and 1, individual. These stations reported for 1907 an income from electric railway service amounting to $1,960,551, as against $138,275 in 1902; from sales of electric energy to other electric companies in 1907, $779,728; from heating, cooking, welding, etc., in 1907, $117.560, as compared with $23,451 in 1902; and from charging automobiles in 1907, $135,121, as against $24,775 in 1902.

Exclusive of the horse-power of gas engines, which was comparatively insignificant, the horse-power capacity reported by all central stations in the United States in 1907 was about two-thirds steam and one-third water. In 1902 the proportions were about three-fourths steam and one-fourth water.

Notwithstanding the gain in kilowatt capacity of dynamos, there was a general decrease in their number, owing to the fact that the average capacity of the dynamos in 1907 was much greater than was reported in 1902.

The extent of the predominance of the small central station is evidenced by the fact that 81.8 per cent of all stations in 1907 and 87.7 per cent in 1902 were under 500-kw capacity, while considerably more than one-half of all—64.4 per cent in 1907 and 71.5 per cent in 1902—were under 200-kw capacity. The commercial stations made the only increase in the class of largest dynamo capacity.

THE "COMPOSITE" STATIONS.

Of the 4714 central electric stations, the "composite" central stations, or those which were operated in connection with other industries, numbered 2066. These stations were associated with 2306 industries of various kinds, the excess of industries being due to the fact that a single central station may be associated with several other industries. The association of central stations with water works and gas plants is the most common, and for the municipal plants there was practically no other. For the commercial stations there were 995 operated in connection with such public services as water works, gas works, street railways, steam heating, and the manufacture of ice, and 573 stations operated in connection with some other business. The central stations associated with such industries as sawmills, gristmills, manufactured ice and cotton gins are likely to be of secondary importance, and owe their existence to the facility with which surplus primary power, by use of the dynamo, may be converted into electrical energy and transmitted for service as light or power to nearby or remote points.

Comparing the sale of electrical energy with that of gas, the report shows an increase in 1907 of 101.5 per cent for the central electric stations and 62.3 per cent for the gas plants.

In 1907, 329 stations reported that they also operated gas plants, but this by no means represents the extent to which the consolidation of the interests of the two industries has been carried, since it does not cover instances wherein the whole, or a controlling portion, of the stock of one industry has been acquired by the other, and the companies are operated under separate management regardless of stock ownership. There is a growing tendency to merge the two industries, partly to avoid the sharp competition whenever they are common bidders for the same class of business.

Municipal central electric light and power plants, or stations, increased more than 100 per cent more rapidly in their number than the commercial stations in the United States. A comparison of the number of reports received by the bureau from municipal stations in 1907 with those received from the same source in 1902 shows an increase of 53.6 per cent as against 23.4 per cent for the commercial companies. In 1907 the municipal stations numbered 1252 as against 815 in 1902.

The proportionately greater increase in municipal stations, the report states, is largely due to the fact they are practically exempt from the consolidations that so frequently occur among the commercial companies.

A further analysis of the reports show that although 33 municipal stations which reported in 1902 had become commercial stations in 1907, there were 113 stations reported as commercial in 1902 which had become municipal in 1907.

The report states that there appears to be a distinct field for municipal electric stations, not only because of a feeling which may exist in many localities that these public utilities should be owned by the cities, but because many of the places in which municipal plants are located do not present sufficient inducement for the investment of commercial capital.

THE NUMBER OF STATIONS.

Comparing the details for municipal stations in 1907 with similar items in 1902, it appears that the cost of construction and equipment in 1907 was reported as $42,879,447, while in 1902 it was $22,020,473; an increase of 94.7 per cent. The gross income of the municipal stations in 1907 was $14,011,999, as compared with $6,965,105 in 1902; an increase of 101.2 per cent. Both sums include the estimated income for energy consumed in municipal buildings and in lighting streets, parks, etc. The gross income in 1907 includes $13,614,434 for electric service, as compared with $6,836,856 in 1902; an increase of 99.1 per cent. Of the amount received for electric service in 1907, there is charged to lighting $13,040,263, while in 1902 the amount was $6,748,863; a gain of 93.2 per cent. The revenue from stationary motors, as a part of the electric service in 1907, was $516,373, and in 1902 it was $70,540; an increase of 632 per cent. All other income from electric service in 1907 amounted to $57,798, as compared with $17,453 in 1902; the per cent of increase being 231.2. All other general sources of income in 1907 yielded $397,565, and in 1902 the amount was $128,249; an increase of 210 per cent.

The immense percentages of increase in income from electric service for stationary motors is conspicuous. The increase in this respect shown for the commercial stations in 1907 was but 184.5 per cent. The municipal stations in 1907 showed a 93.2 per cent increase in the income from lighting while the commercial plants gained 77.8 per cent.

The per cent of increase in total expenses in 1907 was slightly larger for the municipal plants than for the commercial, the former showing 93.4 per cent and the latter 91.3 per cent. The municipal stations' total expenses in 1907 amounted to $9,167,188, as compared with $4,741,182 in 1902.

The number of primary generating machines in the municipal plants in 1907 was 1945 and in 1902 it was 1160, an increase of 67.7 per cent. In this respect the commercial stations in 1907 increased 29.7 per cent. There was in 1907 an increase of 100.9 per cent in the horse-power capacity, 319,847, of the primary generating machines in municipal plants, as compared with 159,193 hp in 1902. The per cent of increase for the commercial plants in 1907 was 122.1. The horse-power of these municipal engines in 1907 was 283,418, as against 147,018 in 1902, an increase of 92.8 per cent. The per cent of increase for the commercial stations in 1907 was 90.1.

An increase in 1907, amounting to 333.3 per cent, was noted in the number, 78, of gas engines in the municipal stations, as compared with 18 in 1902. The commercial stations' per cent of increase in 1907 was 161.9. The horse-power of these municipal engines in 1907 was 6082, an increase of 535.5 per cent over 957 in 1902. The commercial stations gained 343.2 per cent in 1907.

In 1907 the municipal stations were equipped with 2395 dynamos, with 209,016-kw capacity, as compared with 1822 of 113,380-kw capacity, in 1902; the per cent of increase in the number being 31.4 and in the capacity 84.3. The commercial stations in 1907 decreased 8.3 per cent in the number of dynamos, but showed a 127.5 per cent increase in capacity.

The output, in kw-hours, of the municipal stations in 1907 was 289,462,788, as compared with 195,904,439 in 1902, an increase of 47.8 per cent. The commercial stations in this respect in 1907 increased 141.1 per cent.

There was in 1907 an increase of 63.3 per cent in the number of arc lamps and of 156.9 per cent in incandescents wired for service by the municipal stations. The commercial stations showed in 1907 an increase of 41.2 per cent in arcs and of 125 per cent in incandescents.

The stability of the municipal plants is exemplified by the fact that 774 of the 815 plants reported in 1902 also reported in 1907. Of the 41 which failed to report in 1907, 33 had become commercial stations, 4 had discontinued operations or were idle; 2 were connected with public institutions, the plants of which were excluded from the census of 1907; 1 was merged with another municipal plant because of the consolidation of two cities since 1902; and 1 was destroyed by fire and had not been rebuilt at the time of taking the census of 1907.

The total number, 1252, of municipal plants in 1907 was distributed, 150 in the North Atlantic States; 158 in the South Atlantic; 727, North Central; 166, South Central; and 51, Western. Most of the municipal stations are in places of small population, nearly seven-eighths of the total number being located in places of less than 5000 population and less than 3 per cent in places having a population of 25,000 and over.

Telephone Census Report.

There were more than 11,000,000,000 messages, or "talks," over the telephone wires in the United States in 1907, an increase of 124.3 per cent over the approximately 5,000,000,000 similar conversations reported in 1902, according to estimates presented in the Census Bureau's report, now in press, on the census of the physical equipment, service and financial operations of the commercial, mutual and independent rural telephone lines for 1907.

The capital stock and funded debt outstanding in 1907 was $814,616,004, while in 1902 it was $348,031,058, an increase of 134.1 per cent. The income in 1907 was $184,461,747, as compared with $86,825,536 in 1902, a gain of 112.5 per cent. The operating expenses and fixed charges, except interest on funded debt, in 1907, amounted to $128,486,196, as against $61,652,823 in 1902, an increase of 108.4 per cent. The interest on the funded debt in 1907 amounted to $12,316,109, as compared with $3,511,948 in 1902, the per cent of increase being 250.7.

At the census of 1880 the telegraph companies reported the operation of 291,213 miles of wire as compared with 34,305 miles reported for the telephone companies.

Both industries developed rapidly between 1902 and 1907, and by the end of that period the mileage of single wire devoted primarily to the telephone business was eight times as great as the mileage used for the commercial telegraph business.

In the amount of business done in 1907, the amount paid in salaries and wages during the year, and the capital invested, the telephone business was more than 3½ times as extensive as the telegraph industry, and during the year it furnished employment for more than five times as many persons.

In 1907 a total of 14,570,142 miles of wire was in use for the transmission of commercial messages, and of this total 12,999,369 miles, or 89.2 per cent, were used primarily for telephone messages, and 1,570,773 miles, or 10.8 per cent, for the telegraph business.

Between 1902 and 1907 there was an addition of 8,098,918 miles of wire for the use of the telephone systems of the country, as compared with an increase of 259,611 in the mileage of owned and leased wire for the use of commercial telegraph systems.

The increase in the wire mileage of the telephone systems during that period of five years is more than six times as great as the total amount of existing wire that has been added to the telegraph business since 1880, when the first statistics concerning the industry were gathered.

The development of the long-distance telephone system and the increasing use by railway companies of the telephone for the dispatch of business have necessarily had some effect on the extension of the use of the telegraph.

At the close of 1907 the amount of wire in use by the telephone systems of the country exceeded that in use in 1902 by more than 8,000,000 miles. The industry gave regular employment to 65,417 more persons in 1907 than it did five years earlier, and the amount expended in salaries and wages was greater by $32,023,506 in 1907 than in 1902.

The industry is largely concentrated in the populous North Atlantic and North Central States, and the greatest amount of increase between 1902 and 1907 in wire mileage, telephones and business is shown for them.

More rapid rates of increase occurred in other sections, however, and the largest percentages of gain for wire mileage are shown for the Western, South Central and South Atlantic States, where, as a rule, the telephones are farther apart than in the other divisions. The Western States had the largest percentages of increase also in the number of telephones and talks.

The telephone business of the country is divided into two great classes, one known as the Bell and the other as the Independent or non-Bell. Of the total number, 22,971, of systems and lines including independent, farmer or rural lines, represented in the census of 1907, there were 175, or 0.8 per cent, belonging to the Bell system, and 22,796, or 99.2 per cent, to the non-Bell. The Bell system in 1907 operated 8,947,266 miles of wire, or 68.8 per cent of the total, as compared with 4,052,103, or 31.2 per cent, by the non-Bell. The Bell system in 1907 had 3,132,063 stations or telephones, which was 51.2 per cent of the total, and the non-Bell operated 2,986,515, or 48.8 per cent.

The number of telephones, the report states, is probably the most satisfactory measurement by which to determine the relative importance of different companies. Including the farmer or rural lines, the Independent owned 44.4 per cent of the total number of telephones in 1902 and 48.8 per cent in 1907.

In 1907 the Bell system controlled more than one-half of the telephones in the North Atlantic, South Atlantic, South Central and Western divisions, and in 28 of the States and Territories, counting the District of Columbia. In addition to this control, 13.7 per cent of the total number of telephones in the United States were independent telephones operating under exchange arrangements with the Bell system.

Between 1902 and 1907 the wire of the mutual systems and the farmer or rural lines increased by 460,447 miles, or 380.9 per cent, and the number of telephones by 546,542, or 376.8 per cent. In 1907 the miles of wire and the telephones of these two systems formed 4.5 per cent and 11.3 per cent, respectively, of the totals for all systems, whereas in 1902 they formed 2.5 per cent and 6.1 per cent, respectively.

The greatest development of the rural telephone service of the country occurred in the North Central States, which by the end of 1907 contained 68.3 per cent of the wire and 72.2 per cent of the telephones in the rural service.

The commercial systems are operated as business enterprises for profit and now control much the larger portion of the telephone equipment of the country. Of all lines in 1907 they controlled 88.7 per cent of the wires. The conditions prevailing among them necessarily control the industry as a whole. The North Atlantic and North Central States in 1907 contained three-fourths of the telephones and nearly three-fourths of the wire reported for all commercial systems.

The greatest development of the mutual companies occurred in the North Central States, which had 78.8 per cent of the total

number of telephones and 79.1 per cent of the wire belonging to those lines.

There were 24 systems, with 188,258 miles of single wire, and 17,629 stations or telephones, in process of construction in 1907, but had not commenced actual operations.

The report contains seven chapters. The first contains the introduction; the second relates to the statistical consideration of the development of the industry; the third covers physical equipment; the fourth refers to telephone traffic; the fifth treats of the financial statistics; the sixth concerns employees, salaries and wages; and the seventh is descriptive of telephone development. There are three detailed summaries, two appendixes, four maps and three diagrams.

Cost of Electrical Production in Massachusetts, 1909.

An interesting feature of the annual report of the Massachusetts Gas & Electric Light Commission is a tabular presentation of the total cost of producing electricity by all the private companies of the State for the 12 months covered by the returns last received. While it is true that the practice of individual companies is more suggestive specifically when analyzed with respect to the cost of electrical production, the averaging of the records of all the companies in a single locality furnishes an index of the state of the art which is worth noting. During the year ending June 30, 1909, the private plants of Massachusetts generated in round numbers 220,000,000 kw-hours of electricity at an average cost of about 1.2 cents each, exclusive of fixed charges, distribution and general expenses. Including the latter, the total cost, excepting interest, dividends, depreciation and sundries came to approximately 2.85 cents per kw-hour manufactured. Taking into account every possible charge against the kw-hour delivered at the station switchboard, including all fixed and operating costs, the grand total expense per kw-hour generated was just about 4.5 cents. These expenses or disbursements cover no less than 32 items, which amount to a total sum of practically $10,000,000, and of which only about $2,648,000 represents the manufacturing cost at the station. It is easy for the layman to assume that because a plant of modern construction scientifically operated delivers current at the busbar at a cost far below the selling price to the consumer, the margin between his bill per unit and the company's production expense is too large. That this is far from the real status of affairs is clearly indicated by the detailed costs printed in the following table:

COST OF ELECTRICAL PRODUCTION IN MASSACHUSETTS, 1909.

1. Coal or other fuel	$1,205,022.35
2. Rent of real estate used for plant	99,228.93
3. Oil and waste	31,851.27
4. Water	53,895.55
5. Wages at station	667,127.97
6. Station repairs	46,106.98
7. Steam plant repairs	152,107.63
8. Electric plant repairs	80,498.59
9. Apparatus and machinery (miscellaneous appliances)	48,084.36
10. Energy bought	264,143.04
11. Wages, care of lamps and meters, collection costs	351,449.19
12. Repairs and renewals of lines	519,643.50
13. Repairs and renewals of meters, lamps and motors	114,113.15
14. Distribution tools and appliances	102,805.74
15. Carbons	61,901.70
16. Incandescent lamps	313,057.99
17. Globes	4,107.96
18. Directors' allowances	15,251.28
19. Salaries of officers	234,853.03
20. General salaries	481,521.53
21. Rent of offices if separate from plant	30,117.13
22. General office expenses	307,443.54
23. Taxes	829,512.45
24. Insurance	160,810.76
25. Legal expenses	64,779.63
26. Claims	4,013.06
27. Bad debts	29,535.61
28. Incidental expenses	6,062.34
	$6,279,046.26
Interest	411,870.44
Dividends	2,144,202.34
Depreciation	315,815.38
Sundry items	842,365.22
	$9,993,299.64

On the basis of 220,000,000 kw-hours produced the cost of fuel was about 0.55 cent; station wages, 0.30 cent; line repairs and renewals, 0.23 cent. The taxes were more than was paid in wages to plant employees, 0.38 cent. Assuming a distribution efficiency of 65 per cent, the grand total cost of delivering each kw-hour sold at the premises of the consumer would be practically 7 cents, including dividends, interest, and every charge sustained by the companies as going enterprises.

Industrial Development at Gary, Ind.

Gary, Ind., the new town created by the Indiana Steel Company, and which at the age of three years has 22,000 inhabitants and a property investment of $100,000,000, continues to hold out allurements to other large manufacturers, with its unusual advantages of raw material, lake and rail transportation, and Chicago's labor market nearby. The presence of large quantities of cheap electrical energy, generated from the formerly waste gases produced by the blast furnaces, has also been an important factor in the development which this industrial region is undergoing. Several of the largest manufacturing companies of the country have given notice of erecting plants at Gary, and two have already started construction.

The American Sheet & Tinplate Company is building the first "unit" of its mills, on the lake shore just west of the Indiana Steel Company property. By March, 1911, it is estimated this part of the plant will be in operation with 2000 employees. The American Bridge Company is also well along with its new Gary shops, located on ground just south of the American Sheet & Tinplate Company. Both will use large amounts of electric energy for the operation of their plants. This will be derived from the great gas-engine-driven generating station of the steel corporation. About 30,000 kw will be required by these two plants, although details cannot yet be obtained of the uses of this energy. However, the practice of using all alternating-current equipment for rolls, tables, cranes and hoists, which was initiated in the steel company's new finishing mills, is reported to have been forsaken by the engineers for the tinplate company, who have specified direct-current motors for a number of the auxiliary roll operations.

At present, after supplying the service of the steel mills, the gas-engine power plant has an excess of available power, which can be employed to advantage by the new mills. The power represented by the gas from the eight blast furnaces now in operation, is about 110,000 hp, of which 66,000 hp is developed by the engines installed in the present power plant. Work is just beginning on additional blast furnaces, ultimately completing the original design for 16 units. Another generating station will be built, the equal in rating of the first. The combined output of these two stations will then be sufficient for carrying the demand of all the local industries.

Besides the companies above noted, the American Locomotive Company, the American Car & Foundry Company, the National Tube Company and the Gary Bolt & Nut Company have purchased large sites near the steel company's plant, and will shortly begin construction.

Farewell Luncheon to Mr. J. M. Wakeman.

A birthday luncheon was given at the Engineers' Club on Tuesday, June 21, to Mr. James M. Wakeman, retiring vice-president of the McGraw Publishing Company, who will shortly sail for Europe for a prolonged stay in England and on the Continent. The resignation of Mr. Wakeman was due to ill health, and his hosts of friends in this country hope that instead of adhering to his intention of remaining abroad, he will, after a much-needed rest, return to resume active work in the journalistic field.

More than 100 friends of Mr. Wakeman were present at the luncheon, upon invitation of a committee consisting of a number of former and present associates. Mr. T. C. Martin presided as toastmaster with his usual grace. While the affair was quite informal, a number of appropriate tributes were paid to Mr. Wakeman as a business man and as an all-around good fellow, the speakers being Mr. James H. McGraw, John A. Hill, Arthur Warren and Hugh M. Wilson. An amusing feature was the arrival in installments of birthday cakes bedecked with candles, the age of the guest of honor being conjectural until the final cake came to the table.

A beautiful loving cup, which had been presented by the members of the advertising staff of the McGraw Publishing Company, was on exhibition, and Mr. Hugh M. Wilson on behalf of the McGraw Publishing Company presented a 25-volume set in a special binding of the works of Mark Twain, the favorite author of Mr. Wakeman. In accepting the latter gift Mr. Wakeman said that when reading "Innocents Abroad" his thoughts were so strongly turned toward the United States that shortly thereafter he sailed for these shores. Mr. Wakeman's speech was both graceful and appropriate to the occasion. The character of the men present, the spirit of good fellowship and of high regard for the guest of honor all made the affair a notable and pleasing event which those who were so fortunate as to be in attendance will long remember and cherish. Mr. Wakeman will sail for Europe on July 23.

The Use of the Telephone in Transmitting Train Orders.

It is only within very recent years that the telephone has been taken seriously as an agent in transmitting orders for the operation of trains on railroads. However, the growth of train dispatching by telephone, supplementing, or in some cases superseding, the use of the telegraph, has been rapid, and according to the reports of the Interstate Commerce Commission, there were on Jan. 1, 1910, 293 railroads using the telephone for the transmission of train orders on the whole or a part of their systems. The subject is made the basis of a table issued by the Block Signal and Train Control Board of the Interstate Commerce Commission under the date given. This list is designed to include all railroads in the United States on which telephones are used for the transmission of train dispatchers' orders which confer, restrict or change the road rights of trains. It is shown that the 293 railroads using the telephone for train dispatching operate 26,344 miles of road by this method, out of a total of 131,014 miles of road operated. It may be assumed that the Morse telegraph is used for the train dispatching on the 104,670 miles of road representing the difference between the two totals given.

Many of the smaller roads use the telephone altogether, but in the case of nearly all the large steam-railroad systems, the telephone is used for only a portion of the lines. A notable exception is given by the Delaware, Lackawanna & Western, which uses the telephone almost exclusively on its 957 miles of road. The Chicago, Burlington & Quincy operates 2437 miles of its system of 8948 miles by telephone. This railroad makes a more extended use of the telephone for train dispatching than any other system. Other railroads operating more than 500 miles of road by telephone are the following:

Illinois Central, 1706 miles of road out of a total of 4577.
Great Northern, 1511 out of 6536.
Atchison, Topeka & Santa Fé (Eastern lines), 1412 out of 5564.
Pennsylvania System, 1126 out of 5299.
Delaware, Lackawanna & Western, 900 out of 957.
Michigan Central, 757 out of 1792.
Chicago, Rock Island & Pacific, 642 out of 7393.
Chicago, Milwaukee & Puget Sound, 635 out of 1462.
Northern Pacific, 597 out of 5698.
Chicago & Northwestern, 551 out of 7638.

Guayule Rubber.

The Mexican manufacturers of crude rubber from the guayule shrub are forming a strong organization which has for its purpose to fix the price that shall be paid for the product and to protect themselves against the discriminations which they allege is being practiced against this kind of rubber in the principal markets of the world, particularly the United States.

The guayule rubber manufacturing companies and individuals composing this new combine represent a capital aggregating about $65,000,000 gold now invested in the industry in Northern Mexico. The combined capacity of the manufacturing plants is about three hundred tons of crude rubber daily. The reports of the different factories show that those located in the State of Coahuila alone had outputs aggregating $12,000,000 during the first four months of this year, and this is to be still further increased by the erection of new factories of large capacity.

The chief concerns interested in the movement to improve prices and market conditions of the crude product are the Continental-Mexican Rubber Company of Torreon; the Compania Explotadora Coahuilense of Parras; the Mexican Crude Rubber Company of Viesca; the Compania Ganadera de la Merced of Cuatro Cienegas; the Compania Guayulera de Torreon, S. A., of Torreon; the Compania Hulera Mexicana of Gomez Palacio; La Internacional Mexicana of Torreon; the Compania Hulera de la Laguna, S. A., of Torreon; the Compania Huayulera Nacional, S. A., of Gomez Palacio; the Compania Mexicana Explotadora de Hule of Torreon; Othan Kateerfeldt of Gomez Palacio, and Enrico Northoldt of Torreon.

In addition to these concerns it is expected that the rubber manufacturers of the State of Zacatecas will join the organization. Some idea of the importance of this new industry to Mexico may be had when it is stated that in the cutting, packing, freighting and general handling of the shrub and in its manufacture into crude rubber employment is given to 11,500 men, exclusive of an office force of 1143 persons. The daily pay-roll aggregates about $30,000.

The complaint of the manufacturers is that the foreign dealers and brokers in rubber arbitrarily fix a price on the guayule rubber considerably below that which is paid for the Para product and that of rubber trees in other parts of the world without regard to the relative difference in the caoutchie properties of the two products. The fact is cited that while the rubber tree product is accepted on a basis of 90 per cent on its gross weight, an allowance of only 48 to 50 per cent on its gross weight is made for guayule rubber. It is claimed that an analysis of guayule rubber shows that it averages 76 per cent caoutchouc, the manufacturers being therefore deprived of practically one-third of the value of the product in its sale. When the Para and other rubber tree products were selling for $1.25 a pound, offers of only 80 to 90 cents per pound were made for guayule rubber. It is the purpose of the guayule rubber combine to demand an equalization of the prices which will place their product on a parity with that obtained from the rubber tree.

It is probable that one of the methods to bring about the increase in price if the situation cannot be amicably adjusted with the buyers, will be either to reduce the output or store it until the foreign dealers come to terms. The guayule rubber is stated to be in great demand for the manufacture of automobile tires and electrical appliances, and since it is now an important factor in the rubber markets of the world, any curtailment of the output would, it is claimed, be seriously felt.

Mine Inspectors Discuss Underground Applications of Electricity.

The broad uses found for electricity in the operation of mines and in the assurance of safety to the workers below the surface of the ground were well indicated by the trend of the discussion at the second annual meeting of the Mine Inspectors' Institute of the United States, held at the Grand Pacific Hotel, Chicago, June 13-17. The electric lighting of mines, the use of electric hoists and locomotives, the applications of motor-driven ventilating fans, safety lamps supplied from storage batteries, telephones for communication between the galleries and the surface, and firing batteries for setting off blasts, were some of the subjects taken up at these meetings. The institute is undertaking to bring about uniform legislation relating to mine appliances and safety devices, and is carrying out this work along the lines indicated by the mining laws of the State of Ohio, which were passed April 5 and went into effect on June 11 of this year. Mr. George Harrison, chief inspector of mines for the State, is president of the Mine Inspectors' Institute.

The code of electrical rules laid down by the Ohio Legislature, at the suggestion of its mining-expert advisers, is quite complete, although representing the first effort of this kind in any of the States of the Union. The law requires that mine inspectors shall have a practical knowledge of the uses and dangers of electricity as employed at mines. Although in general, inspectors have the right to order changed any condition around a mine which they deem dangerous, the approval of the chief mine inspector must be obtained before changes in electrical wiring or electrical applications can be required. Among the safety appliances stipulated by the Ohio law is a supply of portable electric lamps energized from storage batteries. No steam boilers are permitted within 60 ft. of a mine opening or a wooden building communicating with the mine opening. Trolley wires in mines must be carried at least 6 in. outside of and parallel to the track rail, must be separated by at least 6 in from the roof timbers and be supported at intervals not exceeding 25 ft. No trolley wire shall be extended into a room which is being used as a working place. Switches and circuit-breakers must be installed to control the electric circuits at all important points in the mine. No electric wires shall be extended into any room unless a cable 150 ft. in length will not reach the face of the room. Positive machine feed wires must not be extended nearer than within 4 ft. of the track, and must be disconnected when not in actual use. The return or negative line may be bonded to pipes or rails, but a pipe must not be exclusively used for the return circuit.

The voltage of direct-current circuits used to operate gathering locomotives, mining machines, shearing machines, drills, and other apparatus in working places, must not exceed 325 volts measured at the switchboard. In the case of mines newly equipped with electricity, no alternating current shall be used underground to operate any machinery other than that necessary to convert the alternating current into direct current. Alternating-current mains must be provided with a separate conduit way which is not traversed by men or animals. Where haulage locomotives, pumps or machinery are not located in or about working places of the mine, direct-current pressures exceeding 325 volts may be used, in case the entry or passage ways where lines are carried are not permitted to be used as a principal course of travel. However, no pressure above 650 volts at the switchboard shall be used underground under any circumstances.

Meeting of the New England Section of the I. E. S.

The last meeting of the season of the New England section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of June 13. The subject of the evening was "Illuminating Engineering Considerations," and the speaker was Mr. J. S. Codman. Prior to the technical work of the meeting the election of officers for the ensuing year took place, with the following results: Chairman, Mr. Charles O. Baker; secretary, Mr. William S. Farrow; managers, Dr. Louis Bell and Mr. Walter G. Africa.

Mr. Codman began by referring to the progress of the "flux of light" method of calculating illumination, and also laid strong emphasis on the value of the term "lumen." He called attention to the fact that some of the manufacturing companies have recently published bulletins in which the number of lumens generated by a lamp was recorded among other data, and he followed this by pointing out the desirability of rating all light-sources by the total flux as expressed in "lumens."

He stated that the first and most important question in regard to any light source is the amount of light given off, and this question can only be answered by quoting total flux of light expressed either in mean spherical candle-power or in lumens. The second thing to be known in regard to a light source is the distribution of light. If lamps are rated by their maximum, downward, or mean lower-hemisperical candle-power, no information is given in regard to either of the above important questions. He then quoted from Dr. Steinmetz's recent book, entitled "Radiation, Light and Illumination," in support of his opinion.

The remainder of the talk was devoted to the summary of the different methods which are of commercial value for ascertaining the total flux of a light-source from its photometric curve. Mr. Macbeth's method of finding the mean lower and mean upper hemispherical candle-power by reading the candle-power at 10 special angles in the lower and at 10 special angles in the upper hemisphere and obtaining their arithmetical mean, was first described. This method is one of the simplest for obtaining spherical or hemispherical values, but it is not well adapted to the ascertainment of zonal values.

Mr. Codman then took up the formulas of Mr. Wohlauer, and referred to Mr. Wohlauer's "fluxolite" paper. Mr. Wohlauer has shown that the flux through any zone of the sphere is proportional to the distance from the vertical of the point on the photometric curve which represents the mid-zone candle-power. Mr. Codman showed how this distance can be measured directly in lumens by means of specially prepared scales, or when such scales are not at hand, can be measured very easily by means of an ordinary sheet of paper or a card. He stated that a piece of paper can be laid on the diagram and the candle-power scale of the diagram marked off quickly on the edge and that the distance proportional to the flux can then be measured readily in candle-power. The results in the case of 10-deg. zones can then be translated directly into lumens by multiplying by the constant 1.095, or for rough work, by simply adding 10 per cent.

He then showed that when the value of the flux for several contiguous 10-deg. zones is desired it is not necessary to ascertain the flux values for each zone separately, but instead, the distance proportional to total flux can be determined as follows:

On a straight edge mark the zero of the scale at any convenient point. Then place the zero of the scale on the vertical line of the diagram and lay off on the scale the distance to the first mid-zone point. Next place the point of the scale so found on the vertical line, and lay off on the scale the distance to the next point. This process can be continued for as many zones as it is desired to use, and the final length of the scale will be a measure of the sum of the flux values of the different zones. This value in lumens can be determined by ascertaining the length of the scale in candle-power divisions of the diagram, and then multiplying the result by the constant 1.095.

Finally Mr. Codman suggested that where a great many routine calculations are to be made and the results are to be permanently recorded, the most satisfactory method for ascertaining the flux for each 10-deg. zone is by multiplying the mid-zone candle-power by certain constants. He stated that the most practical manner of using the constants is to use sheets printed with tables giving the constants in a vertical column, with another column for filling in the corresponding mid-zone candle-power values, and a third for recording the products of candle-power values and constants, namely, the flux values in lumens.

Vermont Public Service Commission News.

The Public Service Commission of Vermont has issued an order, under date of June 14, in the petition of State Attorney Benjamin Gates, of Washington County, against the Consolidated Lighting Company, Vermont Power & Light Company, Vermont Telephone & Telegraph Company, and Corry-Deavitt-Frost Electric Company, alleging that the overhead lines of these organizations are maintained and operated in close proximity to each other; that the high-tension wires are either wholly bare or inadequately insulated; and that their condition is unduly dangerous to employees and the public; with the prayer that the defendants, after investigation by the Board, be either ordered to locate their wires under ground or to maintain a system with proper construction over ground.

Hearings were held on the petition at Montpelier, on Feb. 11 and April 27, 1910, and the city of Montpelier, the New England Telephone & Telegraph Company, the Barre & Montpelier Traction Company, the Orange County Telephone Company, and the firm of Moody & Almon appeared and became parties to the proceeding. The Board employed an expert engineer, Mr. F. C. Sargent, Boston, specially to examine the situation and to aid the Commission in determining the questions presented.

In its finding the Board states that from all the evidence it concludes that the allegations of the petition are true. The Board finds, upon the testimony of its engineer and substantial admission of the parties, that the existing conditions in respect to the overhead construction of the several electric service companies operating in the Montpelier-Barre district are without standardization or system; that the pin-spacing is too small for safe repairing of lines; that the needless multiplication of poles and wires makes the streets unsightly and dangerous, while the close proximity of high-tension wires, some carrying energy at 15,000 volts to the telephone wires, causes interference with the telephone service.

The Commission finds "that it would be both unjust and inexpedient, in the circumstancees, to order that this condition be remedied by locating the wires under ground. That work for the city of Montpelier would cost about $33,000, and for the city of Barre about $36,000, making the total cost in the two cities approximately $69,000. We do not think that a reasonable regard for the public safety requires that we should order this expenditure, and we know of no city of the size of these where that has been required."

The Board feels that public safety and convenience require that certain of the poles and wire circuits be rearranged and reconstructed, and that the method of constructing any further additions to the system be in accordance with the detailed specifications contained in the Board's finding, which is the result of an agreement by all parties concerned except Moody & Almon, and which is endorsed by the engineer of the Commission and approved by the commissioners. The order contemplates the rearrangement and reconstruction of these systems on poles above ground, in accordance with certain included specifications and standards, and that all high-tension wires shall, so far as practicable, be carried on pole leads or lines on opposite side of a street from the low-tension lines, but that where such construction is impracticable, low-tension wires and high-tension wires conducting electric energy at a potential not exceeding 5000 volts may be maintained upon a single line of poles in accordance with the standards specified in detail in the order. The Board therefore orders the Consolidated, Vermont, Corry-Deavitt-Frost, New England, Vermont Telephone, Barre & Montpelier, and Orange County companies, with Moody & Almon, to reconstruct their lines in accordance with its specifications. An exhaustive list of improvements is included for specified locations, and valuable appendices are added to the order giving data bearing upon the calculation of line strength, spans, sags, high-tension crossings, joint use of poles, etc. The order is signed by Commissioners John W. Redmond, Eli H. Porter and S. Hollister Jackson.

New York Public Service Commission News.

The construction of rapid transit lines in New York was advanced last week to some extent by several conferences which were held between city officials and Public Service commissioners. At one of these conferences the Mayor, the comptroller, the president of the Board of Aldermen and the Public Service commissioners met President E. W. Winter and other prominent officials of the Brooklyn Rapid Transit Company. The various transit plans submitted by the Brooklyn company in the last few months, particularly that for the operation of elevated trains across the Willliamsburg and Manhattan bridges and through the Centre Street subway loop in Manhattan were discussed. The matter of extension of the trolley service across the Williamsburg Bridge and through the Canal Street subway to North River was also taken up. Of course, no definite action upon these matters has yet been taken. At another conference, the city officials, together with Consulting Engineers Goodrich and Frazee, discussed the form of contracts for the proposed tri-borough subway. It was said that quite a number of flaws were picked in the contracts. The president of the Board of Aldermen announced after the meeting that as all of the city officials had been elected upon platforms pledging city-built subways, the construction by private capital would not be seriously considered unless it could be shown that this arrangement was much more advantageous to the city. The objections to the forms of contract were drawn up in a report and submitted to the Public Service Commission for consideration. The corporation counsel also presented a petition during the week to the Appellate Division of the Supreme Court asking for the exemption from the city's debt limit of $43,887,014. There is no opposition to the petition and early action by the court is expected.

The hearings upon the Third Avenue reorganization plan were continued last week, and Mr. John Flint, of the firm of West & Flint, certified public accountants, was put on the stand by the bondholders' committee. He testified that from the date of the lease of the Third Avenue line to the Metropolitan Street Railway, in May, 1900, up to the appointment of the receiver for the company, $7,395,000 had been spent on construction and equipment by the Third Avenue line. The hearings are being continued almost daily, but as yet there is no indication when they will be ended and a decision reached by the commission.

It is understood that the Interborough Rapid Transit Company will soon ask for a franchise to operate the Steinway tunnel. Governor Hughes last week signed a bill fixing the status of this property. The new franchise can only be for the usual limited period of 50 years, with a possible renewal for 25 years. The franchise in perpetuity which the old company originally had has been abandoned and a new company with the limited franchise will be substituted.

The Public Service Commission, Second District, in considering the matter of the application of the Hartwick Power Company, under section 68 of the Public Service Commissions law, for permission to construct, maintain and operate in the village of Richfield Springs a distributing system for the furnishing of electricity for light, heat and power, has determined that the defects in the service afforded by the Richfield Springs Electric Light & Power Company may be corrected by the exercise of the powers of the commission, and has further decided to deny the application of the Hartwick Power Company upon the condition that the Richfield Springs Electric Light & Power Company will make improvements and betterments in accordance with recommendations of the commission with a view to improving the service, but to give the application further consideration if the Richfield Springs company does not see fit to comply with the commission's suggestions.

During the present week the commission will hear the application of the Dansville Gas & Electric Company for authority to issue $10,000 in mortgage bonds, and also the applications of the Mohawk Hydroelectric Company for permission and approval of the exercise of franchises granted by the town board and superintendent of highways of the town of Ephratah, and for authority to issue $675,000 in capital stock and to issue a mortgage for $3,000,000 and to issue $1,000,000 in bonds to be secured by said mortgage.

The commission has authorized Mary E. Seely and Charles A. Seely to maintain and operate an electric lighting plant in the villages of Spencer and Candor, Tioga County.

The Fulton County Gas & Electric Company has been authorized to acquire from the Mohawk Hydroelectric Company the franchise granted in May, 1910, by the superintendent of highways of the town of Ephratah, Fulton County. The Fulton County company is also permitted to construct and maintain an electric lighting plant in the town of Ephratah.

The Canisteo Gas Company, of Canisteo, Steuben County,

has been authorized to execute a first mortgage covering all its properties to the amount of $50,000 and to issue presently $12,000 par value of bonds. The bonds are to retire outstanding bonds of an equal amount.

The Howard A. Pierce Electric Light Company has been authorized to issue its capital stock to the amount of $12,500 for the purchase of the interest of Howard A. Pierce, Elizabeth Pierce and Laura S. Frank in the electric lighting plant in the village of Hamburg, Erie County. Authority has been given for the transfer of the works, system and franchises of the Howard A. Pierce Electric Light Company for a water-power plant at Water Valley, and the transmission line from Water Valley to the village of Hamburg, Erie County, and the distribution system in the village owned and operated by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank.

Of 7654 tests of meters made during April, 1910, by the New York Public Service Commission, Second District, 533, or 7.23 per cent, were fast; 5828, or 76.14 per cent, were accurate, and 1273, or 16.63 per cent, were slow.

Maryland Public Service Commission News.

The Maryland Public Service commissioners last week expressed the opinion that the commission would have jurisdiction over the franchises granted by the State Roads Commission to the American Telephone & Telegraph Company for a conduit system over the Philadelphia Road, which provides no remuneration to the State. Permission will soon be asked for the same right between Baltimore and Washington over the Baltimore and Washington boulevard. Commissioner Laird pointed out that Section 31¾ of the Public Service Commission act applies to conduits, and that a portion of Section 30 reads: "And be it further enacted that the act shall apply to telegraph companies, telephone companies, telephone and telegraph lines within the State of Maryland and to persons and corporations engaged in the transmission of intelligence within the State by telegraph or telephone."

The Susquehanna Transmission Company last week filed for ratification by the Public Service Commission a franchise granting the use of certain roads in the Fourth and Fifth Districts of Harford County to that company for the purpose of erecting poles. It is said that this company will connect with the lines of the McCall Ferry hydroelectric plant and distribute electricity in Harford County. A public hearing on the franchise has been set.

Several representatives of the Pennsylvania Railroad Company appeared before the commission to assure that body of their willingness to co-operate in carrying out the provisions of the public utility law. They also asked a number of questions relative to the construction placed on certain sections of the law by the commission.

After an explanation from the attorney and the officials of the Consolidated Gas, Electric Light & Power Company, Chairman Ambler announced that the Public Utilities Commission would sanction its sale of $4,000,000 three-year 5 per cent notes and $296,000 bonds to take care of an existing bond issue of $3,584,000 that matures on July 1. The company will be required, however, to report to the commission the use to which the money is put. Previous to the hearing the Consolidated company had filed with the commission an explanation of the need of the issue of the notes.

Rollins & Sons are to purchase the $4,000,000 in notes and the Continental Trust Company of Baltimore is to be the trustee. The bond issue of $296,000 is to be a part of a guarantee fund to the purchasers of the notes, the remainder to be made by bonds in the company's treasury. Inquiry was made by members of the commission concerning the financial plans of the Consolidated company with a view of ascertaining its method of increasing its capital stock. It was testified that all worn-out property was charged against maintenance and new property treated as a basis for new capitalization. Engineer Beadenkopf gave the commission a history of the growth of the company since 1880. Then the consumption of gas amounted to 790,218,000 cu. ft. annually, whereas the consumption in 1909 amounted to 2,994,795,000 cu. ft. The street and service pipes had grown in proportion to the consumption. He declared, furthermore, that it was the policy of the company to maintain its system in the best possible condition, and he cited as an evidence of this that the loss of gas through leakage now amounted to only 3 per cent, whereas it had formerly been as high as 14 per cent.

Wisconsin Rate Commission News.

In the matter of the application of the Badger Telegraph & Telephone Company, of Janesville, to increase certain rates, the railroad commission recently handed down an order giving the company authority to increase the rate 5 cents on all messages into and out of the city of Beloit.

About three years ago the Chicago Telephone Company applied to the City Council for permission to increase its rates. Before acting upon the petition the city required a change in the accounting methods employed by the Chicago Telephone Company. The accounting firm of Arthur Young & Company formulated a system of accounts which the city required to be followed for two years in order that at the end of that period accurate information might be obtained upon which to base further rate action. A report recently made by Young & Company held that the telephone company was earning a very low rate of return upon its alleged valuation. The city of Chicago, reluctant to grant the increase asked for, and apparently unwilling to accept the report as reliable, has retained Mr. H. J. Hagenah, who is in charge of the accounting and statistical department of the railroad commission, to take entire charge of a new and exhaustive investigation of the financial condition of the telephone company with an object of determining the proper valuation of the company's property and the establishment of an equitable system of rates. Mr. Hagenah, who has been granted a leave of absence by the commission, will enter upon his new duties on June 20. In referring this matter to the Wisconsin commission the city of Chicago has recognized the very excellent grade of work which is being done by the commission in matters of valuation and rate making.

On Tuesday the commission handed down its decision in the matter of the complaint of the city of Manitowoc against the Manitowoc Electric Light Company. This petition alleged that the rates charged by the respondent company were excessive and that the service rendered was very unsatisfactory. That the latter complaint was justified was shown by the inspectors' report. Tests made during the month of March showed that out of 31 voltage records taken, 24 were outside of the 6 per cent variation allowed by the commission; of 284 meters tested since Jan. 1 only 44 were found within the 4 per cent requirement at all loads, and of the 240 meters tested later a large majority were found to be slow. The system used is not adapted to the size of the city. The station equipment is of an obsolete type and, although there is a great quantity of copper in the distribution system, it is impossible to get good voltage regulation in the outlying districts. As it stands now consumers are being supplied with direct current as far as two miles or more from the station. The commission has suggested the advisability of installing an alternating-current equipment to supply a portion of the system at least. Inasmuch as plans for these needed improvements are now under consideration by the company, the orders relating to service are to be withheld by the commission for the present.

From an analysis of the valuation of the physical parts of the plant, its earnings and operating expenses and the conditions generally under which it is operated, the earnings of the plant, when considered as a whole, do not appear to be excessive. The street lighting, and, to some extent, the motor business of the plant appear to yield less in revenues under the present rates than the cost of operating these departments when these costs are computed under the methods which have been employed by the commission, but the reasons for this are largely found in the physical condition of the plant and the uneconomical management of the street-lighting system. Con-

sequently the commission did not feel justified in reducing the general rate schedule of the respondent at this time. The rates are to be left practically as they are for the present, with the exception of the schedule of rates for commercial lighting. The present rates are not adjusted upon bases that are as equitable to the different classes of consumers in each of these branches of the service as seems desirable. The company is, therefore, authorized to discontinue its present discount rate system for commercial incandescent lighting and to substitute the schedule of rates as suggested by the commission.

These rates are designed to follow the cost curve as nearly as possible. The distribution of the operating expenses showed no unusual features, as indicated by the following table:

OPERATING EXPENSES OF 38 PRIVATELY OWNED ELECTRIC PLANTS IN WISCONSIN.

	Maximum	Average	Minimum	For Manitowoc
Power	92.5%	60.7%	27.2%	63.5%
Distribution	22.4 "	9.4 "	0.7 "	6.4 "
Consumption	19.5 "	7.1 "	0.6 "	12.1 "
Commercial	14.5 "	4.8 "	0.4 "	4.0 "
General	44.2 "	20.3 "	4.2 "	14.0 "

The total expense of the commercial lighting system, including a fair allowance for depreciation and the present return upon the investment as apportioned to this branch of the service, was about $27,480. It was found that the percentage of fixed capacity and output or variable expenses to the total were approximately 40 per cent and 60 per cent, respectively, or about $10,992 and $16,488, respectively, which agree very closely with the average conditions in Wisconsin. The total connected commercial lighting load for the year ending June 30, 1909, was about 1200 kw. At 50 per cent active, the fixed expense per kilowatt per year of active connected load is $18.32. If the plant is operated one hour per day the cost per kw-hour under these conditions would be 5.06 cents; if operated one-half hour per day, 10.12 cents; two hours per day, 2.53 cents, etc. The total current consumed by commercial lighting consumers during the year was 293,625 kw-hours. Pro-rating the variable expense over the number of units consumed, the variable cost per kw-hour was found to be 5.612 cents. The table of unit costs is as follows:

Capacity	Output	Total	Hours Daily Use of Connected Load
10.12 cents	5.612 cents	15.73 cents	One-half hour
5.06 "	5.61 "	10.67 "	One hour
2.53 "	5.61 "	8.14 "	Two hours
1.68 "	5.61 "	7.29 "	Three hours
1.01 "	5.61 "	6.62 "	Five hours

The following rate schedule was suggested, based upon the above unit costs: 12 cents per kw-hour for first 30 hours' use per month of the active connected load; 9 cents per kw-hour for next 60 hours' use per month of the active connected load; 5 cents per kw-hour for all over 90 hours' use per month of the active connected load.

The following classification is suggested for Manitowoc: Class A, residences, flats, public buildings, etc., active load 45 per cent connected load. Class B, schools, factories, hotels, shops, etc., active load 55 per cent connected load. Class C, stores, offices, barns, saloons, depots, theaters, etc., 70 per cent active. Class D, signs and outlines, 100 per cent active.

From an analysis of the consumer expenses the minimum bill was fixed at 50 cents. The above schedule of rates will possibly be only a temporary one, but it indicates the manner along which further decreases may be effected.

South Carolina Public Service Commission.

Below are given the provisions of an act of the South Carolina Legislature, approved Feb. 23, establishing a public service commission. One of the three commissioners subsequently named is Prof. W. M. Riggs, professor of electrical engineering at Clemson College. The commission has not yet been organized, and the appointment of the secretary will probably not be made until some occasion arises that will lead to a meeting of the body.

The act provides for the appointment of three reputable and competent citizens of the State, by the Governor, with the consent of the Senate, who shall be authorized to fix and establish in all cities of the State maximum rates and charges for the supply of water, gas or electricity, such rates to be reasonable and just.

Upon complaint in writing of 20 or more citizens to the Mayor or Council of any such city, that any person, firm or corporation is charging an unjust or unreasonable rate for water, gas or electricity, the said city, Mayor or Council may request the Public Service Commission to summon such person, the members of such firm or the officers of such corporation to appear before them, with their books relating to such matters, when such examination shall be made as may be necessary to determine whether or not the rates are unjust or unreasonable; and if upon such examination the Public Service Commission shall determine that the rates are unreasonable or unjust, it shall be their duty to fix such rates to be paid for water, gas or electricity as they may deem to be just and reasonable; provided, that in case the Public Service Commission shall fix unjust and unreasonable rates the same may be reviewed and determined by the Circuit Court of the county in which such city is located.

Any such person, firm or corporation now or hereafter owning or operating such water, gas or electric plant, who shall fail or refuse to accept the rate fixed by the Public Service Commission, but instead shall charge a greater amount than that fixed, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not less than $25 nor more than $100; each overcharge to any consumer shall constitute a separate offence, to be recovered in any court of competent jurisdiction, one-half of such fine as may be imposed going to the informer and the other half to go to such city where the complaint arises.

The members of the Public Service Commission shall give a bond of $1,000 for the faithful performance of their duty, and shall each receive the sum of $10 a day while actually employed, and necessary expenses, to be paid by the firm, person or corporation against whom the complaint is made if the rates charged are found to be unjust or excessive, but if otherwise, then such expenses shall be paid by the city authorities wherein the complaint is made.

The term of office of the members of the commission shall be for two, four and six years, respectively, to be determined by lot at their first meeting; and every two years thereafter the Governor shall appoint one member to serve for a term of six years and until his successor is appointed and qualified, any of said members to be removed at the pleasure of the Governor. The act provides that its provisions shall not apply to the cities of Charleston, Marion, Spartanburg, Sumter and Union, or the town of Conway.

Massachusetts Commission News.

The Marlboro & Hudson Gas Light Company has petitioned the Massachusetts Gas & Electric Light Commission for authority to issue new capital stock to the amount of $200,000 to meet the cost of improvements.

A hearing was given by the Board on June 15, upon the petition of the Salem Electric Lighting Company for authority to issue new capital stock to the amount of $312,500 for the payment of notes, purchase of additional land and to provide funds for improvements to be made in the generating plant and underground distributing system. Mr. A. B. Tenney, vice-president, represented the company. He stated that in the past nine years additions have been made to the plant as follows: Real estate, $64,720; steam plant, $151,121; electric plant, $61,-717; overhead system, $16,737; underground system, $1201; transformers, $24,140; meters, $29,201; arc lamps, $2736; Nernst lamps, $12,187. Total, $363,762. The company has entered

into agreement for the purchase of 60,000 sq. ft. of developed wharf property in Salem, and an area of 23,400 sq. ft of undeveloped property, at a cost of $30,000. The improvements to the buildings now in contemplation amount to $68,424. The Legislature of 1910 has passed a law requiring the installation of underground service which will cost approximately $228,097. Contracts for all conduits, manholes and service pipe will be let within the next ten days.

The company filed with the Commission an elaborate statement of the cost of improvements on its system during the past nine years. A new office building has been erected at a cost of $24,603, the building being 34 ft. wide and 142 ft. long, including a storage department, concrete floor, elevator, etc. A large number of improvements have been made in the power station, including a two-story station auxiliary and switchboard room, cutting doors, concreting, extending the boiler house, wharf work, construction of a coal run, the installation of 1,100 kw in engine-driven generating apparatus, pumps and auxiliaries. Various improvements in switchboard equipment and wiring were also made, instruments purchased, etc. Betterments in the overhead system covered the taking down of about 30,000 ft. of direct-current lines, and 30,000 ft. of 500-volt direct-current lines, and erecting in their places single-phase lines and two-phase, 220-volt alternating current service feeders. The expenses on the underground system represented preliminary engineering charges incidental to the layout of this work.

Mr. Tenney stated that the improvements now in contemplation include the erection of additional walls at the power station; the construction of a new book-tile roof, with tar and gravel water-proofing; installation of wired glass windows; erection of steel columns, trusses, etc., and relocation of piping in connection with a traveling crane; substitution of steel bends in place of copper bends in piping; widening the boiler room and building an overhead steel coal bunker of 400 tons holding capacity; installation of stokers, an economizer of 5647 sq. ft. heating surface ($5,295 erected); installation of a steel plate fan for mechanical draft; relocation of a boiler to secure advantageous operation in connection with coal-handling machinery; new coal-handling apparatus, including crusher, elevator, conveyor, gates, etc.; the purchase of a 75-kw exciter set, and the installation of 30,050 ft. of underground conduit, comprising 233,600 duct feet with 90 line manholes and 14 transformer manholes at a cost of $77,815; 500 underground connections at $25,000, with cables, transformers, etc., making a total estimated underground construction expense of $228,097.

Massachusetts Legislative News.

The Massachusetts Legislature of 1910 adjourned on June 15, after a session usually crowded with matters of interest to public utility companies. Questions concerning electric transportation figured largely in the discussions of the senators and representatives, and in the later days of the session several matters of importance were passed from the bill stage into laws. Among these was the authorization of the purchase of the Berkshire Street Railway Company by the New York, New Haven & Hartford Railroad, for the purpose of developing transportation facilities in western Massachusetts, the passage of the bill permitting the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor in connection with its plans for a high-speed interurban road between Boston, Lynn, Salem and Beverly. Other matters which were passed were a resolution requiring the Boston Transit Commission to investigate and report on subway projects for South Boston and Dorchester, and also to make an engineering study of a tunnel from Park Street to the South Station; a resolution, requiring the standard-gauge railroads at Boston to report upon electrification, with a reviewing report by the joint commission on metropolitan improvements; acts limiting the powers of gas and electric lighting companies, bearing upon the dates when stock rights accrue, and concerning change of location; relocation of the terminus of the Riverbank subway in Boston; authorization of the purchase of so-called foreign roads by street railway companies; extension of liability for injuries to passengers riding on the platforms of street cars; provision for temporary locations of street railways, and the passage of a resolution requiring the Railroad and Boston Transit Commissions, sitting as a joint board, to investigate and report upon the advisability of the acquisition by the Boston Elevated Railway Company of the stocks and bonds of other street railway companies.

CURRENT NEWS AND NOTES.

Compulsory Wireless on Vessels.—A bill requiring all vessels sailing from American ports with 50 passengers or more to be equipped with wireless apparatus by July 1, 1911, was passed by the House on June 20. The bill had already passed the Senate.

Tungsten in Argentina.—Of the world's ore wolfram, the tungstate of iron and manganese from which the metal tungsten is obtained, about one-fifth is mined in Argentina. According to United States Minister Sherrill, one mining company, the Hansa Sociedad de Minas, produces six-sevenths of the entire Argentine output. It mines from 60 to 100 tons of ore a month, ranging from 65 per cent to 75 per cent pure wolfram. The price of wolfram is about $1 a kilogram (2.2 lb.) of pure metal. The amount of metal in a ton is estimated by the Government chemical assayer in Hamburg, Germany, where the ore is shipped. The price quoted applies at that place.

The Telephone in Turkey.—Concerning the telephone concession recently granted by the Turkish Government, Mr. Henry L. Janes, secretary of the American Embassy at Constantinople, states that the concession is for the exclusive operation of telephones in Constantinople and environs, and is to run for 30 years from the date of its confirmation by an irade. The construction may be done by the outside syndicate, but the operation must be conducted by a Turkish company, the syndicate being the stockholders. The Government is to have the right to purchase the concession and plant, after 10 years, upon a valuation placed thereon by appraisers, whose mode of selection is set forth in the contract. The syndicate arranging to obtain the concession is composed of the Western Electric Company, New York; the French Thomson-Houston Company, Paris; the directors of the National Telephone Company, London, and the British Insulated & Helsby Cables Company, London. Although the Council of Ministers has approved the concession, it is held in abeyance until submitted to Parliament for approval.

All Alternating-Current Motors in New Axle Mill at Gary.—Following the practice initiated with the design of the new 14-in. and 18-in. merchant mills of the Indiana Steel Company, at Gary, Ind., which employ alternating-current motors throughout, the axle mill now nearing completion shares with them the distinction of having no direct-current lines entering the building except a single pair of wires conveying energy for the electric lifting magnets. These are used for lifting the steel billets from cars and placing them on the platforms of the reheating furnaces. The main rolls are driven by a 500-hp, 6600-volt, three-phase, 25-cycle induction motor, running at 260 r.p.m., which is controlled from a contactor panel employing alternating-current auxiliary circuits of 220 volts. A number of 25-hp and 50-hp motors used to control and raise the tables, conveying rolls, transfers, cut-off saws, etc., are also supplied from the 220-volt secondaries of the mill transformers, a transmission voltage of 6600 being employed about the plant. At the Gary axle mill the process of shaping the axles by the rolls is carried further than at any other plant, requiring less subsequent work in finishing the axles by means of the steam hammers. In the rolls each billet is reduced to practically a round section twice the length of a car axle. Heretofore it has been the practice to attempt only a rough shaping by the rolls. All the crane and hoist motors in this mill are of the alternating-current type.

San Francisco Electrical Show.—August 20 has been fixed for the date of opening of the Pacific Coast Electrical Exposition, which will be held in the Coliseum, and continue eight days.

University of Pittsburgh School of Engineering.—A feature of the commencement exercises at the University of Pittsburgh, on June 15, was the dedication of the School of Engineering on Schenley Farms. Later the formal commencement-day exercises were held in Carnegie Music Hall.

Metric System Advocated by I. E. S.—At the regular June meeting of the council of the Illuminating Engineering Society it was resolved that wherever practicable, metric equivalents be placed in parentheses after English measures in technical papers presented before the society. By this means it is hoped to familiarize readers with the use of the metric system and thus facilitate the ultimate adoption of that system.

Cheap Gas Stimulates Electrical Business.—At a meeting of the Indiana Electrical Contractors' Association, held in Indianapolis on June 14, in response to a question as to the effect of cheaper gas on the business of members, several Indianapolis contractors stated that their business had improved since the introduction of cheaper gas in that city, and expressed the opinion that it is a good thing for the electrical business to have strong competition from the gas interests.

Control of Wireless.—The United States Senate has passed Senator Depew's bill regulating the use of the wireless telegraph. It requires all persons operating wireless stations to obtain licenses from the Department of Commerce and Labor. The purpose is to prevent interference with Government and other important messages. The bill is said to be directed against the 50,000 amateur wireless stations in the country, many of them conducted by boys, the claim being made that in many instances they have prevented the delivery of business messages. The bill has not been passed by the House.

Annual Meeting of the N. Y. E. S.—The New York Electrical Society held its annual business meeting on June 15, at 3 p. m., in the dining room of the new Pennsylvania Railroad Terminal Station. The following officers were elected: President, Mr. Robert T. Lozier; vice-presidents, Messrs. H. L. Doherty, A. S. McAllister, and Ernest Woltmann; secretary, Mr. George H. Guy; treasurer, Mr. Henry A. Sinclair. After the meeting parties of about 25 each were formed in the general waiting room, and headed by guides, inspected the various parts of the station, including the power house and substation.

Electricity in City Improvement.—At a meeting of the City Club of Chicago, on June 9, the manifest advantages of electricity in improving the city in various ways were discussed. The speakers were Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, who spoke on "Electric Power Development"; Mr. E. N. Lake, division engineer of the Board of Supervising Engineers, Chicago Traction, whose subject was "Electrical Transportation," and Mr. H. H. Evans, secretary of the City Council committee on local transportation, who spoke on "Railway Terminal Electrification." Prof. P. B. Woodworth, of Lewis Institute, presided. All the speakers united in declaring that electricity in some of its applications could be used to great advantage in the movement to make Chicago a city possessing greater comforts and beauty than it has at present.

Summer Meeting of Wisconsin Electrical Association.—The executive committee of the Wisconsin Electrical Association, at a meeting held at the office of President Clement C. Smith in Milwaukee on June 15, decided to hold a summer meeting of the association at Oshkosh, Wis., on June 28 and 29. The convention will be called to order on Tuesday, June 28, at the Oshkosh Yacht Club, at 2 p. m. Mr. J. P. Pulliam, of Oshkosh, superintendent of the Wisconsin Electric Railway, is chairman of the local entertainment committee, and he promises that the delegates and visitors will be well looked after. The freedom of the yacht club will be given to those attending the convention, and there will be "doings" at Electric Park, a steamer excursion on Lake Winnebago, as well as other forms of entertainment. There will be no formal papers, but the principal subject of discussion will be "Rates."

Association of Canadian Automobile Manufacturers.—At a meeting held at Toronto, on June 10, Canadian automobile manufacturers formed a branch of the Canadian Manufacturers' Association. The promotion of the automobile industry in Canada and the consideration of matters arising in connection therewith are the objects of the organization. The present members are: Ford Motor Car Company, the E. M. F. Company, the Regal Motor Car Company and the Dominion Motor, Limited, of Walkerville; the McLaughlin Motor Car Company, of Oshawa; the Reo Motor Car Company, of St. Catharines; the Tudhope Carriage Company, of Orillia, and the Kennedy Motor Car Company, of Prescott, and Canada Cycle & Motor Company, of Toronto. The executive committee elected consists of Messrs T. A. Russell, R. S. McLaughlin, R. B. Hamilton, Fred Sager and Hugh T. Tudhope.

Short-Circuiting Rat.—A curious accident in the blast-furnace gas-engine power plant of the Indiana Steel Company at Gary, Ind., was reported recently when a large rat is said to have gotten into the armature winding of one of the alternators, thereby creating a short-circuit, while indulging his taste for empire cloth and insulation. A slight interruption to service resulted. To guard against a repetition of the accident, an advertisement for two cats at 50 cents a head has been inserted in a Gary newspaper. Two months ago in the same plant, a series of remarkable interruptions to the service, resulting in knocking out the circuit-breakers in quick succession, was finally explained when the officials discovered that one of the station engineers, apparently deranged, was in the habit of entering the busbar runway and short-circuiting the buses. He would then rush back to the switchboard and restore service, thereby earning the admiration of the other attendants for his cool-headedness.

Music by "Wireless."—The method of reproducing by magnetic induction, musical and vocal sounds in a pair of telephone receivers connected to a coil of wire held in the hands of the auditor, which was first publicly demonstrated at the Louisiana Purchase Exposition at St. Louis in 1904 is being revived as an amusement feature among a number of summer parks of the country. Entering the enclosure or building in which the "wireless" is installed, the visitor is handed a basket containing a coil of wire, to which a head-receiver is connected. On placing the receivers to his ears, he hears accurately the telephoned phonographic selections of his favorite band or opera singer. The method employed in these amusement devices is to string around the outside of the room or building from 80 to 100 turns of wire, the terminals of which are led out to a telephone transmitter in series with a strong battery of dry cells. A phonograph horn is directed into the telephone transmitter, and currents corresponding to the sound waves are set up in the large coil, which in turn induces a varying magnetic field throughout the building. The small hand-loops connected to the telephone receivers then act as the secondaries of the air-core transformer or repeating coil thus produced. The phonograph attachment and transmitter may be located in a building at some distance from the wireless pavilion, so that no telltale sounds escape to reveal to the auditors that the music they hear is conveyed other than through the ether from a band a thousand miles off. As an amusement device, this scheme has proved quite popular and arouses considerable conjecture as to the way in which the "wireless" music is produced in the telephone. One of these wireless telephone pavilions has been opened up this season at Sans Souci Park, Chicago.

Right of Condemnation for Pole Lines.—The California Court of Appeals has decided that an electric company has the right of condemnation for the purpose of transmission of power. In the case at issue it was held that a payment of $50 per tower erected on private property was a substantial consideration.

Class System on Liverpool Street Cars.—Success has attended the plan inaugurated about two years ago by the municipal railway company of Liverpool, England, of reserving the inside of the cars on one of its routes for first-class passengers, while utilizing the upper deck for other passengers. The plan has recently been extended to a second route. The fare is 2 d. (4 cents) in the inside and 1 d. (2 cents) on the top.

Electric Fan in the Kitchen.—In summer it is sometimes difficult to ventilate kitchens where gas stoves are used, owing to the fact that the draft from the windows may effect the open gas flames. A small electric fan placed at a window only slightly opened can be used to ventilate kitchens without causing the gas flames to flicker and so dissipate the heat. Where gas stoves are used, it is particularly necessary to provide means for ventilating kitchens, because in addition to the needs of the occupants, a large amount of oxygen is required to keep even a few gas burners in operation.

Predatory Powers in Politics.—In a recent address Mr. Robert R. McCormick, president of the Sanitary District of Chicago, discussing the sale of electrical energy by municipalities and private corporations, said: "The managers of the majority of the private enterprises are anxious to manage them without graft and without corruption. At the present time they are unable to do so. There is not a public-service corporation in Chicago or in the country that is not blackmailed every day of its existence for some kind of political favor or other. I think it would be a difficult thing for a public-service corporation to exist in the present condition of political affairs. without yielding more or less to the predatory powers in politics."

Preparation for Chicago's "Sane Fourth".—A feature of Chicago's "sane Fourth" celebration will be a military tournament and army maneuvers by several regiments of regular army troops in a large arena in Grant Park on the Lake Front. This arena will be 400 x 600 ft., bordered on each side by tiers of seats 100 ft. deep. For the night performance it will be lighted by 100 flaming-arc lamps suspended over the field. One of the novel maneuvers planned for the encampment will be an automobile run by a hundred or more machines filled with soldiers, 8 miles through the city to Jackson Park, in response to a wireless-telegraph call for help sent out by the army signal-corps equipment at that point. Army officers are much interested in this wholesale rapid-fire delivery of reinforcements and in the use of "wireless" for summoning aid.

Track Elevation in Chicago.—The work of elevating the tracks of the numerous steam-railroad companies traversing the city of Chicago, begun a number of years ago, is still proceeding in outlying districts. Street railway tracks crossing any section of proposed elevated roadbed must be changed in the subways at the expense of the owners. Likewise all private-owned overhead wires or cables crossing the section of track to be elevated must be placed in some temporarily safe position during the early stages of construction work on notice from the railroad company. Later the crossings must be made in underground conduits or else the wires must be attached to the underside of bridges in the street subways. The work of making this change is done at the sole expense of the owners of the wires, except in the case of overhead wires belonging to the city, which are changed at the expense of the railroad company.

Street Railway Carmen's Request for Co-operation.—It happens that Mr. J. T. Mahoney is at once secretary of the Amalgamated Association of Street and Electric Railway Employees of America (Division 260) and one of the aldermen of the city of Chicago. So Secretary Mahoney prepared a statement which Alderman Mahoney introduced in the City Council relating to accidents in the operation of street-railway cars in city streets. Mr. Mahoney says that the 12,000 men operating street-railway cars in Chicago are good and careful men, mindful of their responsibilities. These men feel hurt at statements relating to their alleged disregard for public safety. If the general public would co-operate with the carmen, rather than expecting them to be almost superhuman in alertness, many accidents would be averted. The communication of the secretary-alderman was referred to the committee on transportation.

Wireless Branch of the Telegraphers' Union.—At a convention of the Commercial Telegraphers Union of America, at Chicago, June 13 and 14, the organization, whose membership includes operators of the telegraph companies, cable service, news syndicates and brokers' offices, in the United States, Mexico and Canada, voted to form special branches for the benefit of wireless-telegraph operators, modifying the constitution so that these might be received as members. It is estimated that there are now more than 1000 wirless operators in this country. The "wireless" members will be formed into divisions taking the names of the employer companies. The membership will also include those operators on shipboard and at foreign stations who care to join. Mr. E. N. Pickerill, of the Waldorf-Astoria station of the United Wireless Company in New York city, is acting secretary for the newly formed "wireless" branch.

Convention of O. E. L. A.—The Ohio Electric Light Association will hold its sixteenth annual convention at Cedar Point, Ohio, on July 26, 27 and 28. Among the papers to be presented are the following: "Experiences with Series Tungsten Lamps for Street Lighting," by Messrs. Claude C. Smith, C. C. Custer and Frank Jackley; "Progress in the Introduction of Electric Vehicles," by Mr. J. T. Kermode; "Turbine Troubles," by Mr. Frank Brosius; "Outline of an Equitable Energy Rate for Motor Service," by Mr. B. H. Gardner; "Methods of Maintaining Electric Meter Accuracy," by Mr. John Gilmartin; "Central Station Facts and Factors," by Mr. J. R. Cravath; "Modern Single-Phase Motors," by Prof. F. C. Coldwell; "The Operation of Low-Pressure Turbines," by Mr. W. C. Anderson; "New-Business Getting," by Mr. L. A. Petit, Jr.; "Purchasing Station Apparatus," by Mr. R. J. Feathers; "Tungsten Lamps Versus Central-Station Earnings," by Mr. E. L. Booth.

Progress on Chicago Drainage Canal Plans.—The North Channel being constructed by the Sanitary District of Chicago from the shore of Lake Michigan, at Wilmette, to the north branch of the Chicago River, has been completed, except for a short distance at its northern end. The motor-driven pumping station, which is to be installed at the lake end of this channel (see *Electrical World*, of May 12, 1910, page 1210), will raise the water 3 ft. from Lake Michigan into the canal. Combining with the flow through the main harbor channel, this water will find its way 30 miles down the Drainage Canal, until at Lockport it undergoes a drop of 30 ft. through the waterwheels of the hydroelectric station, where its energy is converted into electricity and transmitted back to Chicago and to Evanston, where part is used to drive the electric pumps. The cost to date of the entire undertaking of the Sanitary District has been $63,000,000. The proposed Calumet branch of the canal, from Lake Calumet to the Sag, if built, is likely to bring the total cost up to $100,000. According to the figures of the Sanitary District's accountants, the development of electric power at Lockport has cost $4,036,599.

ELECTROMETALLURGY AT PHILADELPHIA MINT.

Electrolytic Parting and Refining of Bullion in the U. S. Mints.

By H. J. SLAKER.

THE methods of refining gold and silver bullion in the Government institutions have been radically changed in the last 10 years. Up to the year 1900 acid processes were used entirely, and it was reserved for the parent mint at Philadelphia to adapt and evolve electrolytic methods which to-day have superseded the older ones in all the Government refineries because of economy and efficiency. The work is now done more cheaply, the product is almost perfect, the neighborhood is not annoyed by fumes, and the by-products are a real source of income.

The problem confronting the Government refineries is to separate the noble metals in a pure state from bullion containing a mixture of gold, silver and base metals, and these in all proportions. An effort has been made to define the relation of the Government to the private refineries through the imposed refining charges so that the bullion will naturally seek its proper place. As the Government offers an unlimited market for all grades of gold bullion, a process, to be satisfactory, must be able to handle greatly varying material, with the result that the operations in the mint refineries have little in common with those in use in private plants. Since silver is almost always present, this metal, too, must be refined. In fact, the system in use is a double one, whereby in the first step the silver is brought up to purity, and in the second, the gold. This explains the terms "silver" and "gold cells."

SILVER REFINING.

The electrolyte for the refining of silver is composed of a 2 per cent solution of silver nitrate with about 2 per cent of free nitric acid held in large stoneware tanks (47 in. x 24 in. x 24 in. deep), 16 of which are in series across the line voltage, each cell thus requiring somewhat less than 1 volt pressure. The anode is made up by selection from the deposits which the Government has paid for and so adjusted that 40 per cent is gold, about 47 per cent silver and the remaining 13 per cent the base that was in the original material. This proportion of gold and silver has proved to be the most suitable for the extraction of the greatest percentage of silver from the anode, and it has been found after much experimenting. The above mixture is melted, thoroughly stirred and cast into ingots (16 in. x 3 in. x ½ in. thick), with a ¼-in. hole at the top for the purpose of suspension. The ingots are slipped into a bag and hung in the electrolyte by means of a small gold hook. The object of the bag is to prevent the cathode, which is lifted out every eight hours and the loose crystals scraped off, from coming into contact with the anode, thus picking up small amounts of gold and defeating the purpose of refining.

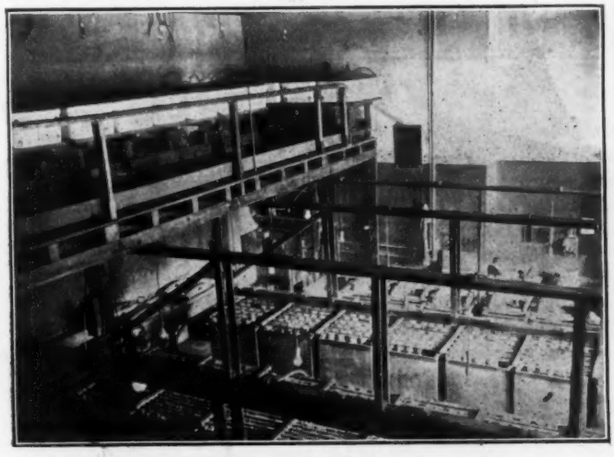


Fig. 1—Arrangement of Tanks for Silver Cells.

As is usual with all commercial electrolytic plants, a good contact is difficult to maintain because of the fumes, the corroding solutions and the fact that the voltage is low and the current is high. This difficulty is completely solved in the Philadelphia mint by using gold hooks for suspending the anodes, which in turn are in contact with thin silver strips half rounded along a hard-rubber tube reinforced through the center by a steel rod. The steel rod gives strength and is not corroded because of the protection of the hard rubber, which in turn is not attacked by fumes. The silver carries the electrical energy from one cell to the next and distributes it through the gold hooks to the anodes. On account of the large percentage of base in the anodes a low current density of from 5 amp to 7 amp per square foot is used to induce a knob-shaped crystal in preference to the usual fern-like one so often seen with silver. The addition of glue to the electrolyte for this purpose has been discontinued. Once every eight hours each cathode is removed and the loosely adhering crystals are scraped into a dish; the same cathode being used until it becomes too heavy, when it is washed, melted and a new one put in its place.

Fig. 2—Anode and Cathode for Silver Cells, Showing Knob-Like Crystals.

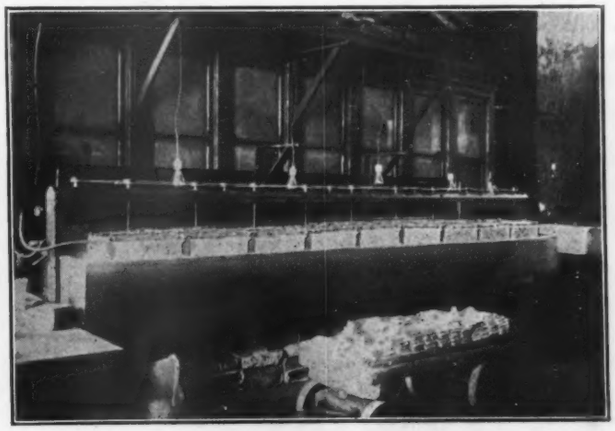


Fig. 3—Nine Gold Cells in Series and System of Circulation.

If no base metal were present in the anode this process might be carried on indefinitely with the same electrolyte, with a slight addition of acid perhaps, but the 13 per cent of base metal offers a serious difficulty by the fouling of solutions. The relative amount of silver nitrate must be kept practically constant if a pure and reguline deposit of silver is to be ob-

tained, and as the current dissolves silver plus base metal at the anodes, but deposits only silver at the cathode, the strength of silver nitrate in the electrolyte is depleted by the amount of base metal dissolved, and has to be replaced from an outside source. The base metal accumulates in the electrolyte, so there comes a time when the foul solution has to be replaced by new in order to insure a good deposit.

The foul electrolyte presents many interesting problems be-

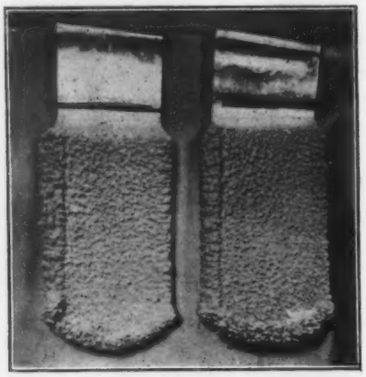


Fig. 4—Character of Gold Deposit.

cause it contains all the metals which would be soluble in a nitrate solution. Just what becomes of the valuable metals platinum and palladium in this step of the process are questions to which particular attention has lately been given. It has been proved that in the electrolytic parting cell for silver, a small portion of the platinum in the anode does pass into solution, and, indeed, there are indications that an exceedingly small amount is plated out again with the fine silver.

The method used for finding the platinum in the electrolyte is cheap and easily adaptable for the recovery of this valuable metal from large quantities of solution. The present method of treating the foul electrolyte is to pump it into stoneware tanks where, with insoluble iron anodes, the silver content is reduced to a low value by the electric current, after which the remaining silver is precipitated as chloride by sodium chloride, while the solution is allowed to pass off to the sewer. Upon the anode surface lead peroxide gradually forms, thus protecting the iron, and this proceeds until sufficient weight is gathered when the anode is removed and the deposit knocked off.

A relatively small amount of silver peroxide and traces of palladium peroxide are found in this black deposit on the anode, which are regained from the metallic lead after reduction by carbon in a small blast furnace. The product from the silver cells, about 300,000 oz. per month, rarely runs below 99.9

Fig. 5—Platinum Sponge, By-Product.

per cent fine, and generally will carry less than 1 oz. of gold to the 100,000 oz. of silver. This refined silver is cast into convenient sized bars, with no fluxing, and is either used for coinage or is sold to the trade.

GOLD REFINING.

The anodes for the gold cells are generally made from the worked-out anodes which come from the silver cells, but, of course, any deposit, if fine enough, can be put directly into these cells. This product, if from the silver cells, is washed, melted and cast into anodes of suitable size (8 in. x 3 in. x ½ in. thick) for the gold cells and suspended in an electrolyte composed of 10 per cent hydrochloric acid and about 3 per cent of gold as gold chloride.

The jars used are of royal Berlin porcelain (19 in. x 15 in. x 12 in. deep), set in a sand bath heated by steam so that the temperature in the electrolyte is about 125 deg. Fahr. The circulation is accomplished by means of small hard-rubber propellers driven by a belt from an electric motor giving them a rotation of 700 r.p.m. A current density of 70 amp per square foot is used for the grade of anodes made in the Philadelphia mint, but with anodes richer in gold, and facilities for eliminating additional fumes, this density can be largely increased. The product is usually above 99.95 per cent gold with the greater part of the impurity silver, which does not detract from the working qualities to even a slight degree.

The slimes and the electrolyte contain all the metals which were in the anodes, and it is here that most of the platinum and palladium gradually accumulate. When the solution becomes foul the platinum is precipitated by sal-ammoniac as

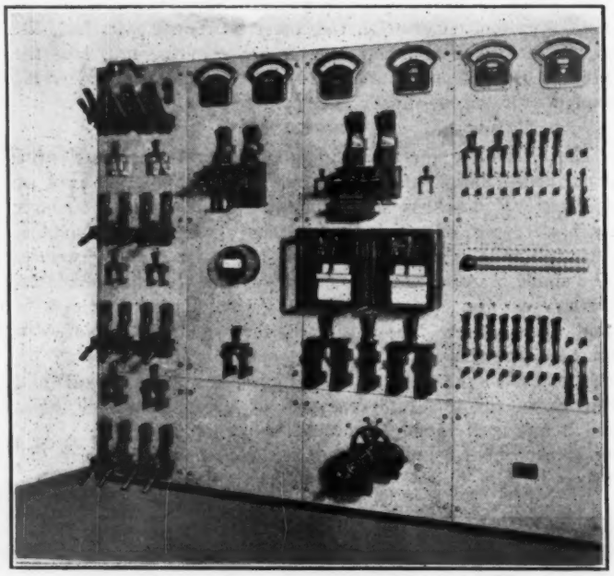


Fig. 6—Switchboard.

platinum-ammonium chloride, which is carefully washed and upon heating yields spongy platinum. This by-product of platinum is sold at intervals by the Government and is a source of income heretofore lost, and only because of the accumulation of traces in the electrolytic process is its recovery possible.

The amount of platinum in any deposit is generally so small that ordinary laboratory methods fail to detect it except as a trace, thus rendering it impossible to make any returns to the depositor. Much smaller amounts of the rare metal palladium are also recovered at this step in the process by an ingenious method, which, when perfected, may be the subject of a future note.

The slimes produced are chiefly a mixture of silver chloride and a finely divided gold, and at times a small amount of grains of iridium. To this mixture, after washing, is added some granulated zinc, which reduces the chloride to metallic silver, and after washing a second time, the whole is melted into bars to be used, after proper alloying, in the silver cells as anodes.

EQUIPMENT.

Recently the refinery in Philadelphia has been equipped with a new five-panel switchboard (12 ft. long and 8 ft. high) of

polished Vermont marble, built by the Walker Electric Company. There are some features about the board which are considered particularly desirable for the practical control and study of an electrolytic plant since it gives a record of just what happens, from a voltage and current standpoint, in all the cells or in any particular set at any hour of the complete day. A description of the various panels will bring out these points more clearly.

The first and second panels control the 220-volt lines representing several lamps and motor circuits, while the remaining three are used for the low-voltage or electrolytic circuits entirely. Each lamp and motor circuit is protected by a double-pole, independent-arm circuit-breaker with a double-pole switch on all except two, and these circuits carried to the top of the board are distributed from this point to the various rooms. The watt-hour meter shows the total energy delivered to the board, which gives the amount to be charged to the refinery for each month's work.

The energy delivered to the board, less the amount consumed for lighting, etc., is greater than that actually used in the cells because of the large loss of transforming 220 volts to 15 volts, and also because of the drop in transmission of heavy currents at such low voltage. Not more than 55 per cent of the energy delivered ever does work in the cells. A time-limit device was added to the circuit-breaker which protects the motor-generator set in order to allow the heavy machines to get up speed without opening the circuit. This acts on the principle of a dashpot, and by a simple arrangement the hole through the piston can be relatively increased or decreased, thereby giving a control to cover different conditions and at the same time afford ample protection.

The panel controlling the output of the low-voltage dynamo has a 2000-amp, reverse-current circuit-breaker with a recording ammeter and a recording voltmeter mounted below. The reverse-current feature of this circuit-breaker protects the measuring instruments when the motor-generator set is shut down, since at such time the electrolytic cells feed back into the line and reverse the current. The recording instruments, which are of such type that a 60-day continuous record can be obtained, are so arranged that a single circuit or any combination can be recorded by a simple change of connections. This is a valuable feature when one wishes to know the current conditions for the full 24 hours, and is particularly desirable for all experimental work.

The last two panels, one for the gold cells and the other for the silver cells, are identical, with the exception that the one for the gold cells is arranged to carry heavier currents. There are 20 circuits allowed for on the silver panel and 12 on the other, and each circuit is so connected that by throwing a single-pole, double-throw switch down the indicating ammeter is included in the circuit, while throwing it up cuts the instrument out. A plug device gives the voltage at the terminals of any set of cells and the plugging holes are numbered to correspond with the circuits. As the gold cells are located at a distance from the silver cells, and from the main board, so the panel controlling them is near the gold cells and connected to the main board by a 600,000-circ. mil cable. A drop of 2 per cent in the leads has been allowed for from the panels to the cells.

The low-voltage dynamo, built by the Bogue Company, stands close to the switchboard with heavy busbar connections and is excited by 220-volt current. A rheostat, with motor control, is in series with the field winding, thus allowing the voltage-regulating switch to be in the superintendent's office.

This machine has carbon brushes throughout and has double commutator which allows, by a single change of connections, either 30 volts with 750 amp, or, as operated, 15 volts at 1500 amp. The carbon brushes may reduce the electrical efficiency somewhat, but the gain in the machine's reliability to work at full load 24 hours a day, with little attention, offsets this lack of efficiency, especially when the plant is dependent upon one dynamo. The large commutator necessary in order that 112 carbon brushes (1¼ in. x ⅞ in.) can be properly arranged allows an excellent opportunity for ventilation of the armature, and the slow speed, 650 r.p.m., insures a long life.

COLORADO HYDROELECTRIC INSTALLATION.

The Glenwood Generating Station of the Central Colorado Power Company.

IN the issue for Jan. 27, 1910, an article was printed on the transmission lines of the Central Colorado Power Company. In that article was shown a general map of the large system which this company is building to supply energy to the large mining camps and cities of Colorado. A description was given of the 100,000-volt transmission line which the company has had in operation since July, 1909, between its Shoshone plant, near Glenwood, and Denver, a distance of 153 miles.

The plant at Shoshone, which it is the object of the present article to describe, was placed in operation July 17, 1909, and was the first of the company's water-power plants to begin operation. It was built to utilize the fall of the Grand River in the canyon of that river about 10 miles above the city of Glenwood. The power plant is just across the canyon from the Denver & Rio Grande Railroad tracks, and is thus within plain sight of one of the great lines of transcontinental railroad travel.

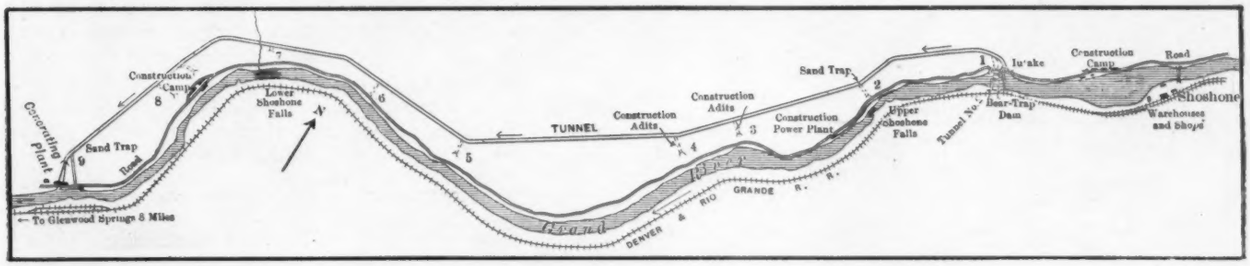


Fig. 1—Map of the Glenwood, Col., Development.

This plant is one of a system of several plants which the company contemplates installing, each of which plants will have different characteristics suiting it to work in connection with the others. The drainage area of the Grand River above the plant is 4500 sq. miles. The Glenwood plant is without terminal storage and is intended simply to take the regular flow of the Grand River, furnishing a minimum output of about 5000 kw.

The Boulder plant of this company, which is to be described in a later article, has a very large storage capacity, which suits it for taking heavy peak loads and tiding over emergencies. It is less than 30 miles from Denver, the largest and most important market. Another peak-load plant is also contemplated in the Gore Canyon on the Grand River some distance above Glenwood. The comprehensive scheme also contemplates the use of certain regulating reservoirs in the upper waters of the Grand River in order to increase the minimum flow of that stream.

In Fig. 1 is shown a general map of the water-power de-

velopment at the Glenwood plant. It comprises the following principal features: First, a diverting dam; second, a 2.5-mile tunnel in the side of the canyon, from the intake at the dam to the power house; third, a pressure pipe line at the power house end of the tunnel to the power house; fourth, a power plant operating with water at 170-ft. head

The maximum discharge of the Grand River, in common with

Fig. 2—Interior of Tunnel.

other Colorado mountain streams, is during the melting of snow in June. The average daily discharge for June for 10 years was 13,358 cu. ft. per second. The maximum daily discharge noted was 29,000 cu. ft. per second. The minimum discharge is in the winter during December, January and February. The 10 years' average for these three months has been over 700 cu. ft. per second, the minimum recorded being as low as 400 cu. ft. per second.

The diverting dam across the Grand River at the intake will create an intake pool, which will have a capacity of 1250 cu. ft. per second for 2.5 hours, or 600 cu. ft. per second for 10 hours in addition to the discharge of the river. Thus a very limited storage capacity is afforded by this dam. For use during construction of the permanent bear-trap dam at the intake, a temporary rock-filled crib dam was constructed just above the permanent dam. The power house was in regular operation some time before the completion of the permanent dam. The bear-trap dam is in four sections and is 245 ft. long; it occupies all of the available space between the vertical rock walls of the canyon. The leaves of the bear-trap dam raise the water level for winter storage 9 ft. above the permanent crest of the dam.

The tunnel is of a gravity flow section, arranged for a flow of 1250 cu. ft. per second; it is 12,453 ft. long. The tunnel section is 16 ft. 8 in. wide at the top, tapering to a slightly narrower section at the bottom. It is 11 ft. deep at the center. The bottom is slightly curved, which not only gives a good hydraulic section, but makes the construction easier than for a section with sharp corners. For about 90 per cent of the distance the tunnel is through solid blocky granite. About 10 per cent of the total length was through material which required timbering and a concrete arch roof. In the solid rock section the walls are lined with concrete 9 in. thick at the bottom, tapering to 6 in. thick at the top; the floor lining is 6 in. thick. An early view of the tunnel in rock section is shown in Fig. 2. False forms were used inside the lining and the space between the rock and these forms was filled with concrete muck from the tunnel. The work of driving this tunnel was carried on from nine different adits, the position of which can be seen in Fig. 1. Since the tunnel was completed adit No. 9 has been used as a spillway or wasteway.

The forebay was not designed as a terminal reservoir to supply water for sudden peaks, but simply to carry the water easily from the tunnel section into the penstocks. The storage afforded by the water in the long length of tunnel is considered ample for any sudden load which may come on the wheels. Provisions are made for gauging the depth of water at the intake and also at the various adits. The adits used only during construction have been closed up with concrete walls, but access to the tunnel can be had at these points. The method of operation is to keep the forebay full of water while the tunnel at the intake may be only partially full, this depending, of course, on the load which is being carried. At adit No. 1, which is near the intake, there is also an overflow

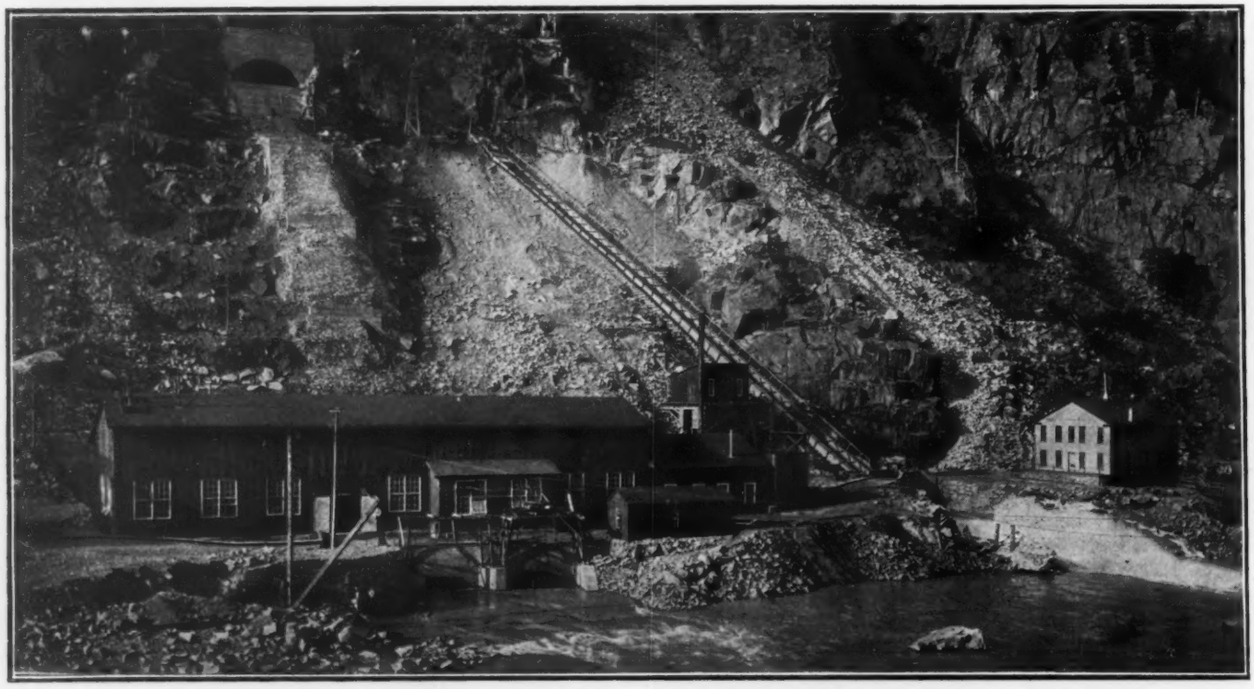


Fig. 3—View of Glenwood Station, Central Colorado Power Company.

spillway to provide for any surplus water which might accidentally be let into the tunnel during flood periods. At adit No. 2 a sand trap was constructed by doubling the area of the tunnel so as to reduce the velocity of the flow.

The two penstocks are 9 ft. in diameter. Their thickness varies from 0.25 in. at the top to 0.5 in. at the bottom. The thrust of the pipe line is taken by a heavy anchorage at the lower end of the central portion.

The power house building, Fig. 3, was designed as a temporary structure, as it is expected at some future time to continue the tunnel further down the canyon and build a power plant for a higher head lower down the river. The present building is of structural steel frame with corrugated steel sides and Carey's roofing. It is 139 ft. long by 35 ft. wide, with a bay for the pump and switchboard. A repair shop 35 ft. x 39 ft. at the upstream end has also been provided. A plan of the power house is shown in Fig. 4 and an elevation showing the arrangement of the apparatus is illustrated in Fig. 5. The water-wheel equipment comprises two 9000-hp turbines. They were furnished by the I. P. Morris Company and made under the designs of Mr. W. M. White, hydraulic engineer of that company. These wheels are provided with governors of Mr. White's design. Each of the two wheels is directly connected to a 500-kva generator of General Electric design, having the following characteristics:

Five thousand kilowatts at 100 per cent power-factor, with temperature rise of 35 deg. C. in 24 hours; 7500-kw at 100 per cent power-factor, with a temperature rise of 55 deg. in two hours. These alternators are 60-cycle, 4000-volt, star-connected, 18-pole, and run at 400 r.p.m. The guaranteed efficiency at full load is 96 per cent. Each has an exciter of 120 kw on the main shaft, one exciter being sufficient for both alternators. Fig. 7 shows the power-station interior.

The electrical connections of this plant are very simple Each generator is connected to the busbars through a motor-operated oil switch of 1200 amp rating. The switches and busbar compartments are arranged along one side of the building, which is at the top in Fig. 4. From the busbars the current passes through a totalizing oil switch to the transformers. There are no switches in the station on the 100,000-volt side of the transformers, all of the switching being done on the low-tension side. All of the 100,000-volt switches on the system are located at substations. The control switchboard is on the opposite side of the power plant from the oil switches and 4000-volt wiring. Nothing but 125-volt circuits are carried to the control board. Series instrument transformers are located under the oil switches and shunt instrument transformers are placed on the wall of the station just above these switches. The leads for the shunt transformers are brought from the terminals of the switches, that being the most convenient place to tap the station wiring. The leads from the generators to the switches consist of two 700,000-circ. mil cables for each leg of the circuit, this being cheaper than providing one large cable of sufficient capacity as well as more convenient to handle. Cable ducts consist of Orangeburg fiber conduit laid in concrete. For the 700,000-circ. mil cables, these are 3 in. inside diameter.

The shunt instrument transformers are protected by expulsion of cannon-type fuses. The totalizing oil switch in the line between the busbars and the transformers are of 200-amp rating. Disconnecting switches are provided on each side of this switch.

The transformer equipment, Fig. 6, consists of three 330-kw transformers, oil insulated and water cooled. These raise the e.m.f. from 4000 to 100,000 volts. They are connected in delta on the high-tension side, and, of course, the line is not

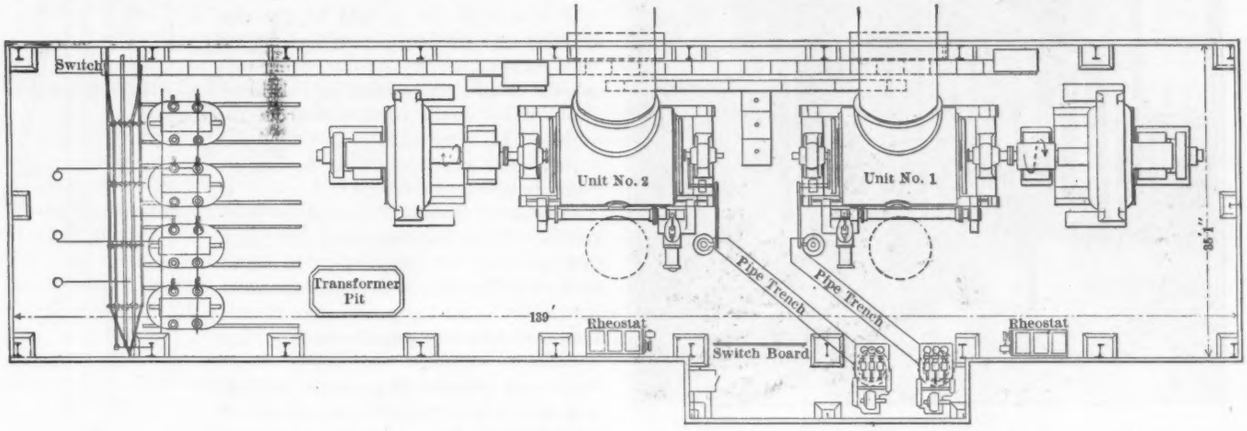


Fig. 4—Plan of Glenwood Station, Central Colorado Power Company.

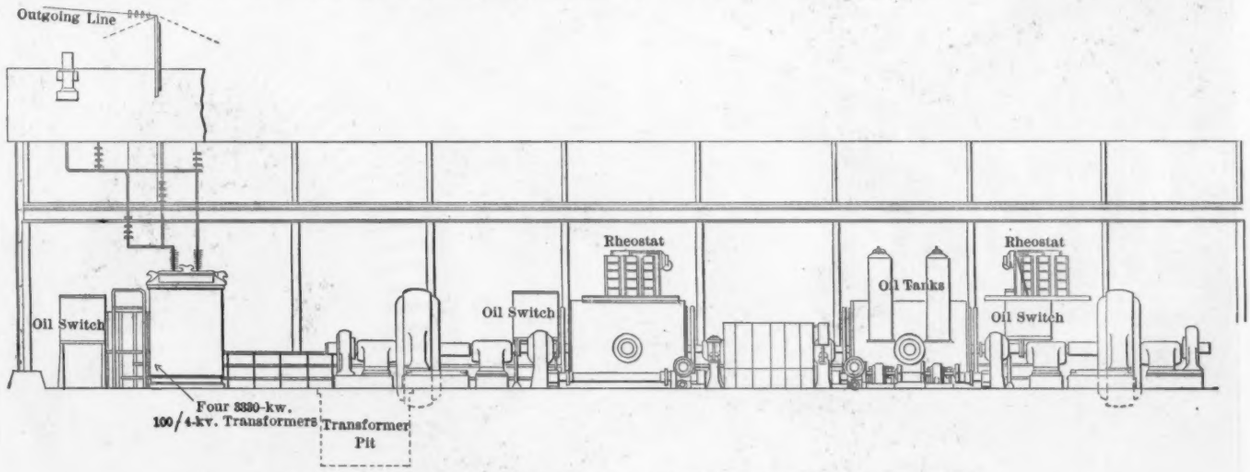


Fig. 5—Elevation of Glenwood Station, Central Colorado Power Company.

grounded. As seen from the power house plan, the arrangement is such as to provide for a fourth transformer for reserve. The power house is spanned by a 35-ton Whiting crane. Each transformer is on a small truck with a short length of track, so that in case a transformer burns out it can be wheeled from under the high-tension connections above it and lifted by the crane. In order to provide head room for lifting out transformer core and coils, a transformer pit is provided as shown in Fig. 4, and the transformer casing can be lowered into this pit by the crane, after which the head room will be sufficient to lift out the coils. In connection with the operation of the crane it is interesting to note that the experience of this company has shown that even though a crane in a location of this kind is infrequently used after the power house is in operation, it pays to install a motor-operated crane rather than one hand-operated, because of the time saved during construction.

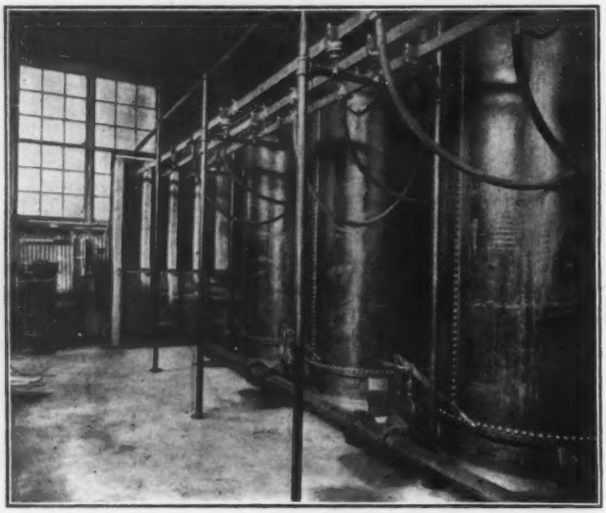


Fig. 6—Step-up Transformers in Glenwood Power House.

The transformers used have a guaranteed efficiency of 98.5 per cent at full load. Their guaranteed voltage regulation is 1.2 per cent from full load to no load with 100 per cent power factor. A 24-hour run at full rated load raises the temperature by 35 deg. C. A 50 per cent overload for 2 hours causes a temperature rise of 55 deg. Each transformer weighs, with oil, 52,000 lb. The height over all to the top of the high-tension terminals is 15 ft. 6 in.

The 100,000-volt busbars over these transformers are arranged for varying conditions of the different transformers in case one is put out of service. These busbars consist of seamless brass tubing of the same dimensions as extra-heavy 1-in iron pipe. It is held by the suspension-type disk insulators such as are used on the high-tension line, being suspended from the ceiling and held in position by strain insulators from the walls. The same pipe is also used for transformer connections by having its ends flattened and drilled.

One of the specially interesting high-tension wiring features about this plant and some of the company's substations is the roof bushing or insulated entrance lead which is used as a substitute for the methods entering power stations and substations through the walls, which have been common in previous practice. Fig. 8 is a sectional drawing of one of the bushings. They are of General Electric Company manufacture. The length is nearly 9 ft. over all. In some cases the length has been increased to 11 ft. Of this length about 5 ft. is above the roof. The high-tension conductor is a rod which is held in the center of a long fiber tube about 8 in. in outside diameter. This tube is filled with a thick black high-tension insulating compound. The upper part of the tube is protected by seven disk insulators about 16 in. in outside diameter, under which is a standard sewer tile, the top diameter of which is 12 in. and the diameter of the bell at the roof 20 in. inside.

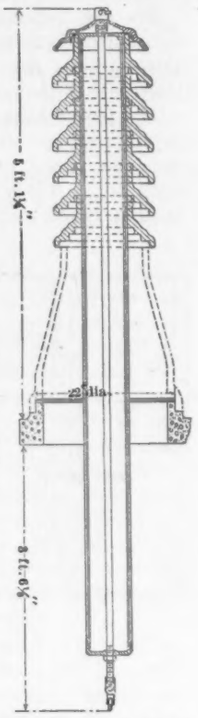


Fig. 8—Roof Bushing for 100,000 Volts.

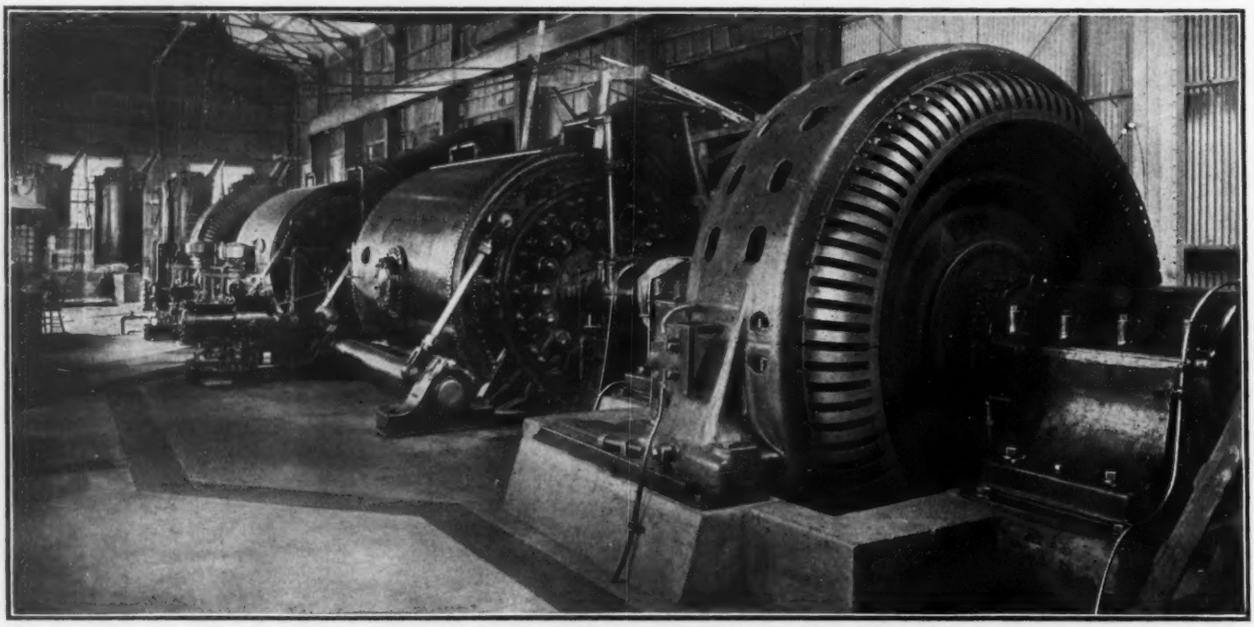


Fig. 7—View of Interior of Glenwood Power House.

The voltage of the generators is maintained by means of

one Tirrill regulator, which can be operated on either or both exciters.

Each generator panel contains one ammeter, one voltmeter, one power-factor indicator, one indicating wattmeter and one ammeter for the field circuit. Automatic time-limit overload relays are provided for opening the generator circuit. There are three switches motor-controlled from a generator panel. One of these is the main oil-switch motor, besides which there is one field rheostat motor and one small motor which operates the governor of the water wheel to raise or lower the speed of the generator when preparing to synchronize.

TRANSMISSION LINE EQUATIONS.

Calculation of the Electrical Constants of Transmission Circuits.

BY C. P. STEINMETZ.

The equations given by Mr. J. F. H. Douglas in the *Electrical World* of April 28, 1910, are very simple and close approximations of the quantities involved in long-distance transmission lines, and it is believed that the present article, which derives the equations directly from line constants and discusses their accuracy, may be of some interest.

Let l = distance along the line, from some given point; $\dot{E}$ = voltage and $\dot{I}$ = current at point l; $\dot{Z}_0 = r_0 - jx_0$ = line impedance per unit length (for instance, per mile); $\dot{Y}_0 = g_0 - jb_0$ = line admittance, shunted, per unit length; that is, r_0 = ohmic effective resistance; x_0 = self-inductive reactance; b_0 = capacity susceptance—that is, wattless charging current divided by volts—and g_0 = power component of capacity admittance—that is, power component of charging current, divided by volts.

Then, in a line element dl, the voltage $d\dot{E}$ consumed by the impedance is $\dot{Z}_0 I dl$, and the current $d\dot{I}$ consumed by the admittance is $\dot{Y}_0 E dl$; hence,

$$\frac{d\dot{E}}{dl} = \dot{Z}_0 \dot{I}, \tag{1}$$

$$\frac{d\dot{I}}{dl} = \dot{Y}_0 \dot{E}. \tag{2}$$

Differentiating (1) and substituting (2) therein gives,

$$\frac{d^2\dot{E}}{dl^2} = \dot{Z}_0 \dot{Y}_0 \dot{E}, \tag{3}$$

and from (1) follows

$$\dot{I} = \frac{1}{\dot{Z}_0} \frac{d\dot{E}}{dl}. \tag{4}$$

Equation (3) is integrated by

$$\dot{E} = \dot{A}\epsilon^{Bl} \tag{5}$$

and, (5) substituted in (3) gives

$$B = \pm\sqrt{\dot{Z}_0 \dot{Y}_0}; \tag{6}$$

hence, from (5) and (4)

$$\dot{E} = \dot{A}_1\epsilon^{+\sqrt{\dot{Z}_0\dot{Y}_0}l} + \dot{A}_2\epsilon^{-\sqrt{\dot{Z}_0\dot{Y}_0}l} \tag{7}$$

$$\dot{I} = \sqrt{\frac{\dot{Y}_0}{\dot{Z}_0}}\left\{\dot{A}_1\epsilon^{+\sqrt{\dot{Z}_0\dot{Y}_0}l} - \dot{A}_2\epsilon^{-\sqrt{\dot{Z}_0\dot{Y}_0}l}\right\} \tag{8}$$

Writing,

$$\left.\begin{aligned} l &= l_0 = \text{entire length of line,}\\ \dot{Z} &= l_0\dot{Z}_0 = \text{total line impedance,}\\ \dot{Y} &= l_0\dot{Y}_0 = \text{total line admittance,}\end{aligned}\right\} \tag{9}$$

and substituting (9) into (7) and (8),

$$\left.\begin{aligned} \dot{E}_1 &= \dot{A}_1\epsilon^{+\sqrt{\dot{Z}\dot{Y}}} + \dot{A}_2\epsilon^{-\sqrt{\dot{Z}\dot{Y}}}\\ \dot{I}_1 &= \sqrt{\frac{\dot{Y}}{\dot{Z}}}\left\{\dot{A}_1\epsilon^{+\sqrt{\dot{Z}\dot{Y}}} - \dot{A}_2\epsilon^{-\sqrt{\dot{Z}\dot{Y}}}\right\}\end{aligned}\right\} \tag{10}$$

that is, the current and voltage at the generator end of the line.

If now $\dot{E}_0$ and $\dot{I}_0$, respectively, are the current and voltage at the step-down end of the line, for $l = 0$, substituting $l = 0$ into (7) and (8),

$$\left.\begin{aligned} \dot{A}_1 + \dot{A}_2 &= \dot{E}_0,\\ \dot{A}_1 - \dot{A}_2 &= \dot{I}_0\sqrt{\frac{\dot{Z}}{\dot{Y}}}\end{aligned}\right\} \tag{11}$$

Substituting in (10) for the exponential function the series

$$\epsilon^{\pm\sqrt{\dot{Z}\dot{Y}}} = 1 \pm \sqrt{\dot{Z}\dot{Y}} + \frac{\dot{Z}\dot{Y}}{2} \pm \frac{\dot{Z}\dot{Y}\sqrt{\dot{Z}\dot{Y}}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{24} \pm \frac{\dot{Z}^2\dot{Y}^2\sqrt{\dot{Z}\dot{Y}}}{120} + \cdots$$

$$= \left(1 + \frac{\dot{Z}\dot{Y}}{2} + \frac{\dot{Z}^2\dot{Y}^2}{24}\right) \pm \sqrt{\dot{Z}\dot{Y}}\left(1 + \frac{\dot{Z}\dot{Y}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{120}\right) \tag{12}$$

arranging by $(\dot{A}_1 + \dot{A}_2)$ and $(\dot{A}_1 - \dot{A}_2)$, and substituting therefor the expression (11), gives

$$\left.\begin{aligned} \dot{E}_1 &= \dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2} + \frac{\dot{Z}^2\dot{Y}^2}{24}\right\} + \dot{Z}\dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{120}\right\}\\ \dot{I}_1 &= \dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2} + \frac{\dot{Z}^2\dot{Y}^2}{24}\right\} + \dot{Y}\dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{120}\right\}\end{aligned}\right\} \tag{13}$$

If $l = l_0$, that is, $\dot{E}_0$ and $\dot{I}_0$ at the generator side, $\dot{E}_1$ and $\dot{I}_1$ at the step-down side of the line, merely the sign of the second term of equation (13) reverses.

It therefore follows: if Z = total impedance, Y = total shunted admittance of a transmission line, and $\dot{E}_0$ = voltage and $\dot{I}_0$ = current at one end, $\dot{E}_1$ = voltage and $\dot{I}_1$ = current at the other end of the transmission line,

$$\left.\begin{aligned} \dot{E}_1 &= \dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2} + \frac{\dot{Z}^2\dot{Y}^2}{24}\right\} \pm \dot{Z}\dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{120}\right\},\\ \dot{I}_1 &= \dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2} + \frac{\dot{Z}^2\dot{Y}^2}{24}\right\} \pm \dot{Y}\dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6} + \frac{\dot{Z}^2\dot{Y}^2}{120}\right\};\end{aligned}\right\} \tag{14}$$

where the plus sign applies if $\dot{E}_0$, $\dot{I}_0$ is the step-down end, the minus sign if $\dot{E}_0$, $\dot{I}_0$ is the step-up end of the transmission line.

In practically all cases, the quadratic term can be neglected, thus,

$$\left.\begin{aligned} \dot{E}_1 &= \dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2}\right\} \pm \dot{Z}\dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6}\right\},\\ \dot{I}_1 &= \dot{I}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{2}\right\} \pm \dot{Y}\dot{E}_0\left\{1 + \frac{\dot{Z}\dot{Y}}{6}\right\},\end{aligned}\right\} \tag{15}$$

and the error made hereby is of the magnitude of less than $\frac{z^2y^2}{24}$

With the exception of very long lines, usually the second term of the second term can also be neglected, thus,

$$\left.\begin{aligned} \dot{E}_1 &= \dot{E}_0\left(1 + \frac{\dot{Z}\dot{Y}}{2}\right) \pm \dot{Z}\dot{I}_0,\\ \dot{I}_1 &= \dot{I}_0\left(1 + \frac{\dot{Z}\dot{Y}}{2}\right) \pm \dot{Y}\dot{E}_0,\end{aligned}\right\} \tag{16}$$

and the error made hereby is of the magnitude of less than $\frac{zy}{6}$ of the line impedance voltage and line charging current.

Example. Two hundred miles of 60-cycle line, on non-inductive load.

e_0 = 100,000 volts,
i_0 = 100 amp.

Line constants, as taken from tables, are:

$\dot{Z} = 104 - 140\,j$ ohms,
$\dot{Y} = 0.0013\,j$ mhos.

Hence, using equations (16)

$\dot{Z}\dot{Y} = (0.182 + 0.136\,j)$,

$\dot{E}_1 = 100{,}000\,(1 - 0.091 - 0.068\,j) + 100\,(104 - 140\,j)$
$= 101{,}400 - 20{,}800\,j$,

$\dot{I}_1 = 100\,(1 - 0.091 - 0.068\,j) - 0.0013\,j \times 100{,}000$
$= 91 - 136.8\,j$.

The error is

$$\frac{zy}{6} = \frac{0.174 \times 0.0013}{6} = \frac{0.226}{6} = 0.038.$$

Second term of $\dot{E}_1$,
the error is:

$0.038 \times 17{,}400 = 660$ volts $= 0.6$ per cent.

Second term of I_1,

$$yE_0 = 130;$$

the error is:

$$zI_0 = 17{,}400;$$

$$0.038 \times 130 = 5 \text{ amp} = 3 \text{ per cent.}$$

Although the charging current of the line capacity is 130 per cent of output current, the error in the current is only 3 per cent.

Using the equations (15), which are nearly as simple, brings the error down to:

$$\frac{z^3y^3}{24} = \frac{0.226^3}{24} = 0.0021, \text{ or } < 0.25 \text{ per cent.}$$

Hence, only in extreme cases the equations (14) need to be used. Their error would be less than $\frac{z^4y^4}{720} = 3.6 \times 10^{-4}$, or one three-thousandth per cent.

The accuracy of the preceding approximation can be estimated by considering the physical meaning of Z and Y.

Z is the line impedance, hence ZI the impedance voltage, and

$$C = \frac{ZI}{E},$$

the impedance voltage of the line, as a fraction of total voltage.

Y is the shunted admittance, hence YE the charging current, and

$$D = \frac{YE}{I},$$

the charging current of the line, as a fraction of total current.

Multiplying C and D gives,

$$CD = ZY.$$

That is, the constant ZY is the product of impedance voltage and charging current, expressed as fractions of full voltage and full current, respectively. In any economically feasible power transmission, irrespective of its length, both of these fractions, and especially the first, must be relatively small, and their product, therefore, is a small quantity and its higher power negligible.

In any economically feasible constant potential transmission line, the preceding approximations are, therefore, permissible.

RADIATION FROM METALS.[1]

Discussion of Investigations Relating to the Selectivity of Metallic Filament Lamps.

By Edward P. Hyde.

In a previous paper[2] before the New York Section of the Illuminating Engineering Society the author, in collaboration with Messrs. Cady and Middlekauff, presented the results of the application of two new photometric methods to the study of the selective[3] radiation of certain metals. These two methods are described in some detail in the papers to which reference is made, so that it is unnecessary to discuss them here. It might be well, however, to repeat briefly the assumptions which are involved in the two methods.

If it is admitted that of the power supplied to an incandescent filament mounted in an exhausted bulb, as in ordinary commercial lamps, that lost by conduction and convection is small compared with that radiated[4], the two photometric methods give positive qualitative criteria of the relative selectivity of the radiation from the various filaments investigated. Thus, suppose two filaments operated at such voltages that the ratio of the energy radiated in some wave-length in the red end of the visible spectrum to that radiated in some wave-length in the blue end of the spectrum is the same for both. If under this condition the two filaments show quite different lumens per watt it must follow that the partition of energy in the complete spectra of the two is different, and hence one radiates selectively with respect to the other. This is a necessary conclusion irrespective of any other knowledge whatever regarding the properties of either substance, either in the visible or in the infra-red region of the spectrum.

Should the two filaments under the given condition have the same lumens per watt, it is *probable* (particularly for carbon and the metals studied), though not *necessary*, that the two infra-red energy curves should agree throughout. In other words, if the lumens per watt are found to be the same there may or may not be relative selectivity, though for the substances studied the latter alternative is more probable; if the lumens per watt are found to be different there is without question relative selectivity.

The quantitative measurement of the selectivity rests on the assumption that if two metals when at the same relative distribution of energy for two wave-lengths in the visible spectrum show different lumens per watt, the filament having the lower lumens per watt is at the higher temperature. This is probable from what is known regarding the reflective power and other properties of metals. On the basis of the assumption the numerical differences between the lumens per watt of the various filaments indicate in every case the minimum value of the difference in efficiency due to selectivity.

In the former discussions of these methods the condition of comparison of the various filaments has been stated as being a "color match," or the same distribution of energy in the visible spectrum as determined with a spectro-photometer. As a matter of fact, when the *relative* emissivities at two wave-lengths not too near the extremes of the visible spectrum are the same for any two of the various filaments studied, observations with the spectro-photometer show that over the entire range of the spectrum within the two given wave-lengths the distribution of energy is the same for the two filaments to within less than 2 per cent, perhaps less than 1 per cent. Moreover, the integral colors, as seen in an ordinary Lummer-Brodhun contrast photometer are closely the same. Osmium alone seems to differ enough to be noticeable, and the corresponding spectro-photometric measurements show the slightest evidence of a relative depression in the middle of the visible spectrum, making the integral color slightly purplish compared with carbon.

As the measurements of relative energy in the spectra of carbon and tungsten, for example, are carried out into the deep red, and infra-red, as with a bolometer, the relative distribution must gradually become different since the lumens per watt under the given conditions are much greater for tungsten than for carbon. It is difficult to understand, however, how two filaments could show markedly different relative distributions of energy well within the visible spectrum, and still be at a color match, as was recently found by Coblentz.[5]

OBSERVATIONS OF SELECTIVITY.

In the previous paper, on the basis of the assumption stated above, numerical data were given of the relative selectivity of carbon (as it occurs in the various types of commercial carbon lamps), tantalum, tungsten and osmium. Since then it has been possible through the use of very special lamps made of platinum wire to determine the position of platinum in the series mentioned above. The results obtained with platinum, together with the values found for the Lummer-Kurlbaum electrically heated "black body," which had been studied previously, are of considerable interest because the "black body"

[1] Abstract of a paper presented before the American Physical Society, Washington, April 22, 1910.

[2] *Trans.* I. E. S., Vol. IV, p. 334; 1909. See also *Elec. World*, Vol. 53, p. 439; 1909; *Phys. Rev.* Vol. 27, p. 521; 1908; *Illum. Engineer* (London). Vol. 2, pp. 241, 335; 1909.

[3] Throughout this paper the term "selective radiation" is used to signify merely a different distribution of energy from that radiated by a "black body" at the same temperature. The term is not used in this paper to imply pronounced bright lines or bands in the spectrum, as is frequently understood.

[4] This conclusion has been corroborated by Drysdale (see London *Illum. Engineer* Vol. 1, pp. 27 et seq.; 1908) and Fery & Cheneveau (see *Bull.* de la Société Internat. des Electriciens, Series 2, Vol. 9, p. 655; 1909), while Lux (see London *Illum. Engineer*, Vol. 1, p. 98; 1908) has found quite appreciable differences between the energy in-put and that radiated.

[5] Bureau of Standards *Bulletin*, Vol. 6, No. 3, p. 301; 1910.

and platinum have constituted the two reference points for much of the published data on the radiating properties of various substances.

It was not feasible at the time to determine the lumens per watt of the "black body," so that the results on the "black body" were obtained solely by the other method, namely, that of measuring the ratio of the change in candle-power to that in watts when the "black body" was operated at such a temperature that its radiation matched in color that from the standard lamp at the chosen voltage. The results found for the "black body" place it at the head of the list, all of the filaments showing selectivity in different degrees, but in the same direction, namely, in favor of the shorter wave-lengths. Untreated carbon comes nearest to the "black body," but there is indication of a very small selectivity even for that.

The measurements on the "black body" which were carried out two years ago were made possible through the courtesy of Drs. Waidner, Burgess and Coblentz, of the Bureau of Standards, who kindly placed two different electrically heated "black bodies" at the disposal of the author.

Platinum was studied by both of the photometric methods, and at two different temperatures. The results in every case indicated that its position in the series lies between the carbons on the one side and tantalum on the other. In other words, it is more selective than carbon in any of its forms, but not as selective as tantalum, tungsten or osmium, which lie in the order named, osmium being much more selective than tantalum.

The results obtained for platinum are of especial interest because platinum has commonly been considered as deviating farthest from "black body" radiation. As has been pointed out several times, this deviation may arise either from a low emissivity throughout the spectrum or from a pronounced selectivity, or from a combination of these. It is quite possible that platinum may deviate farthest, when both emissivity and selectivity are considered, but from the standpoint of selectivity which alone determines the photometric efficiency, all three of the metals, tantalum, tungsten and osmium, are more selective, judged by the photometric criteria, and making the assumption stated in an earlier paragraph. On the basis of the same assumption, Henning[6] recently deduced lower limiting values of the emissivity for various metals. He found as the lower limit for platinum 0.17, for tantalum 0.27, for tungsten 0.40, and for osmium 0.62. Thus, platinum probably has a lower emissivity than tantalum, tungsten or osmium, all of which in turn are more selective than platinum. These lower limiting values for the emissivity of the various metals, tantalum, tungsten and osmium, can be obtained roughly from the red "black body" temperatures at color-match pitch, as pointed out in the previous paper[7] by Cady, Middlekauff and the author.

The apparently independent variation in the two variables, emissivity and selectivity, emphasizes the significance in the study of selectivity of making the basis of comparison the same *relative* emissivity at two wave-lengths for the various filaments rather than the same *actual* emissivity at some one wave-length. Thus, when tungsten and treated carbon, for example, are at such temperatures as to have the same *relative* emissivity at, say, $\lambda = 0.66\mu$ and $\lambda = 0.5\mu$ (which amounts to a color match), the tungsten shows a value of lumens per watt from 20 to 40 per cent higher than that of treated carbon, the amount of the difference depending upon the absolute temperature at which the comparison is made. If, on the other hand, tungsten and carbon are at such temperatures as to have the same *absolute* emissivity at $\lambda = 0.66\mu$ experiment shows that the difference in lumens per watt between the tungsten and the carbon is approximately twice that at color match. Therefore, of the difference in lumens per watt between tungsten and carbon when operated at such temperatures that the energy emitted at $\lambda = 0.66\mu$ is the same for the two, approximately one-half is due merely to the different *emissivities* of the two substances, the remaining half being due to selectivity.

[6] *Zs. für Instrk.*, Vol 30, p. 74; 1910.
[7] *Trans. I. E. S.*, Vol. IV, p. 351; 1909.

LAWS OF RADIATION.

In connection with a mathematical investigation of the various laws of radiation a very interesting deduction from the Wien law of spectral energy distribution was made and tested experimentally. The generalized form of the Wien equation may be written as follows:

$$J = C_1 \lambda^{-a} E^{-\frac{C_2}{\lambda T}}$$

in which λ = wave-length, T = absolute temperature in degrees centigrade, and C_1, C_2, and a are constants. For a "black body" $a = 5$. It has frequently been assumed that this equation, with different values of the constants, may be taken to represent the radiation from platinum and other metals.

If it be assumed that this equation with different constants may be employed to represent the distribution[8] of energy in the visible spectrum of the various metals, it is easy to show that if two filaments are at a color match at low temperature, and are brought again to a color match at higher temperatures, the ratios of the candle-powers of the two filaments must always be the same over whatever range of temperature the comparisons are made. This conclusion results only if the constant "a" remains constant over the range of temperature. If instead of the Wien equation use be made of that of Planck, which is more rigorous for a "black body," the same deduction follows for all ordinary temperatures, since the measurements are confined to the short wave-lengths of the visible spectrum.

This conclusion seemed to be verified quite closely by the data which had previously been obtained with another end in view. The experiment was carried out anew, however, with all three of the metals, tantalum, tungsten and osmium, using carbon as a comparison source. For the first two metals mentioned the relation between color and intensity as compared with carbon persisted accurately over a large range of temperature; for osmium some slight deviation was observed, such that if carbon and osmium were brought to a color match[9] (that is, as close as possible) at low temperature, and then again to a color match at a somewhat higher temperature, the ratios of the candle-powers of the two filaments were not quite the same at the two temperatures.

Since the above observed relation was deduced on the assumption of the Wien (or Planck) equation with "a" constant, the results of the experiment indicate that if the distribution of energy in the visible spectrum is represented at any temperature by the Wien (or Planck) equation, it is represented by the same equation with the same value of "a" for all temperatures over a relatively wide range for tantalum and tungsten. The deviations found for osmium are such as would result from a very small change in "a" with temperature.

The conclusion that if the Wien or Planck equation (in its general form) is assumed to represent the distribution of energy in the visible spectrum of the metals studied at any temperature, then "a" must remain constant, or very nearly so, over a moderately large range of temperature, is in contradiction to the published results of other recent experiments[9]. The cause of the discrepancy is to be found, quite probably, in the fact that the Wien equation (which was assumed in the investigation to which reference is made) does not represent the distribution of energy accurately throughout the spectrum, so that "a" may be considered as a function of the wave-length rather than of the temperature. Whether or not the Planck equation[10] in its generalized form can be taken as representing the energy distribution in the spectra of metals is yet to be determined.

[8] The exact assumption is not that the Wien equation represents the distribution of energy in the visible spectrum, but rather that it gives the ratio of the energy emitted at two wave-lengths in the visible spectrum, taken for convenience as far apart as practicable (say $\lambda = 0.66\mu$ and $\lambda = 0.5\mu$). The experiments described in subsequent paragraphs in terms of distribution in the visible spectrum, or of "integral color," were in every case checked spectrophotometrically, using two wave-lengths in the visible spectrum. But since the two methods agreed as to results the terms "integral color" and "color match" are used as short-hand expressions of the more exact conditions.
[9] Coblentz, *Bureau of Standards Bulletin*, Vol. 5, No. 3, p. 329; 1909. Also *Elec. World*, Vol. 52, p. 1345; 1908.
[10] *Phys. Rev.*, Vol. 29, p. 553; 1909.

From a consideration of the published results showing "a" to vary with the temperature, it is immediately seen that the observed values of "a" lead to an inconsistency. Thus, if Wien's equation for spectral energy distribution is assumed, the Stefan-Boltzmann law for the total emission, $E = \sigma T^{a-1}$, must follow, since it is the integral of the Wien equation from $\lambda = 0$ to $\lambda = \infty$. But the observed values of "a," as, for example, in the case of platinum, decrease so rapidly with the temperature that if substituted in the Stefan-Boltzmann law they lead to the absurd conclusion that the total emission at 1200 deg. abs. is about 2×10^6 times the total emission at the higher temperature, 1400 deg. abs.

It has been stated that if the Wien or Planck equation with "a" greater than 5 (the value for a "black body") represents the energy distribution in the spectra of metals, then "a" *must* decrease with increasing temperature, or else at sufficiently high temperatures the total emission of the metal would be higher than that of a "black body." The observed decreasing "a" was therefore thought to be in accordance with the requirements of the theory. But apart from the criticism that the observed changes in "a" are so great as to lead to the absurd conclusion that the total emission decreases with increasing temperature, the theoretical conclusion that "a" must decrease needs some consideration.

As stated above, the Stefan-Boltzmann law follows as the direct integral of the generalized Wien equation. It also follows as a direct integral of the generalized Planck equation, but the value of the constant "σ" is different in the two cases. As deduced from the Wien equation

$$\sigma = C\,T(a-1)\frac{1}{C_2^{a-1}}$$

As deduced from the Planck equation, which is

$$J = C_1 \frac{\lambda^{-a}}{E^{\frac{C_2}{\lambda T}} - 1}$$

"σ" has the value

$$\sigma = C_1 T(a-1)\frac{1}{C_2^{a-1}} \sum_{n=1}^{n=\infty} \frac{1}{n^{a-1}}$$

In either case "σ" is a function of "a," and so undergoes change with change in "a." As a matter of fact, at ordinary temperatures (up to 2300 deg. Abs.) and for ordinary values of "a" (up to $a = 8$) a decrease in "a" produces not a decrease but an actual increase in the total emission E. There is, therefore, no reason, from the consideration of the total emission, why at ordinary temperatures "a" should decrease with increasing temperature. Moreover, it is not clear to the author why the burden of responsibility has been placed upon the constant "a" rather than upon one of the other constants C_1 and C_2, both of which enter in the Stefan-Boltzmann law. It might be argued that a very small *increase* in C_2 with the temperature would prevent the total emission from rising too rapidly in cases where "a" is greater than 5. It may be significant in this connection that changes in C_2 with the temperature would not affect the relation between color and intensity, which was employed to show that if the Wien or Planck equation represents the energy distribution in the spectra of metals at any temperature the constant "a" must remain approximately constant at different temperatures.

CONCLUSIONS.

From the data at hand the conclusion would seem to be that the Wien equation in its general form does not represent the distribution of energy in the spectra of metals, at least of the metals platinum, tantalum, tungsten and osmium. The variations in the observed values of "a" on the assumption of the Wien equation are due probably to variation with λ (which, of course, means that the equation does not represent the facts even at any one temperature) rather than to variation with the temperature, as has been suggested. But since the Wien equation is known not to represent the radiation even from a black body in the longer wave-lengths of the infra-red spectrum, it is not surprising that discrepancies should result when it is assumed to apply to the radiation from metals. It is a matter of further investigation as to whether or not the radiation from metals can be represented accurately by the generalized Planck equation, which in its specific form for a "black body" has a theoretical basis, and is verified approximately by experiment.

From the theoretical deduction, verified experimentally for tantalum and tungsten, regarding the relation between color match and intensity match it follows that if the generalized Planck equation is found to hold for metals at various temperatures, then "a" must be constant or quite closely so, independent of temperature over the range of ordinary temperatures. The so-called constant C_2 may or may not vary as far as the above considerations are concerned. Osmium shows peculiar behavior which makes it an interesting subject for further study.

Physical Laboratory,
National Electric Lamp Association.

AN ELECTROMAGNETIC COMPASS.

An electromagnetic compass, which is especially suitable for use on board ironclad boats, has been invented by Louis Dunoyer, who recently presented to the French Physical Society a description of this interesting apparatus, together with an account of practical tests made on board the French cruiser *Patrie*.

This novel compass may be arranged to transmit readings of the external magnetic field to a blockhouse, or to a place where they are before the eyes of the captain. Compensation can be made within a few minutes without any knowledge of the magnetical meridian.

The electromagnetic compass is based on the terrestrial inductor principle. The coil C performs a rapid uniform rotation around a vertical shaft $A\,B$, the end of which carries a small motor M. This motor is an enclosed machine and the shaft AB is long enough to make the magnetic influence of the motor on the field in which the coil C is rotating quite negligible. This shaft is rigidly connected with a collector formed by two conductive half rings KK_1 to which the terminals of the coil are joined up. The half rings are insulated from one another by the sectors TT' situated at the opposite ends of the same diameter; the plane through the shaft AB and the middle of the sectors is parallel to the windings. The collector is provided with two brushes D and D_1, the contact surfaces of which are the same width as the sectors—they are likewise diametrically opposed. The brushes are fitted on brush-holders fixed on the frame carrying the whole rotating part, which frame in its turn is rigidly connected to the vessel. The brushes D and D_1 are connected to a movable-coil galvanometer G, through plug resistance box R. The concave mirror of this galvanometer is mounted on pivots and forms on a ground glass screen Δ the image Ox of the filament of an incandescent lamp L.

As seen in the illustration, the whole of this system is duplicated. In fact, the rotating coil comprises another winding C which, as far as possible, is identical with the winding C, being connected to the half-rings K' and K'_1 which are insulated from one another, and from the half-rings K and K_1; A pair of brushes D' and D'_1 are connected to a second galvanometer G'; the axis of rotation of which is perpendicular to the former, and its concave mirror forms on the ground glass Δ the image Oy of the filament of the lamp L.

During the rotation of the coils the mean currents traversing the galvanometer are proportional to the sine and cosine of the angle between the axis of the ship and the horizontal component of the earth's magnetic field, and the line joining the crossing points of the two images to the center of the ground glass screen gives the direction and magnitude of that component.

The rotating system, including the brushes and leads, is termed the transmitter, while the two galvanometers, and their auxiliary apparatus, constitute the receiver. The transmitter is located at some part of the vessel where it is protected against shocks, and where the magnetic field is sufficiently well defined and stable. The ship bottom, far below the water line, is especially suitable in this connection, and a transmitter there installed would be destroyed only in case of destruction of the whole vessel. The receiver should be located in the blockhouse, under the eyes of the captain and pilot. The six wires connecting the two parts of the apparatus should be installed in the armored conduits connecting the blockhouse with all the principal parts of the ship.

The electromagnetic compass permits of ready compensation both for the permanent and temporary magnetism of the ship. As the ship is swung, the crossing point of the lines of light describes on the glass screen an ellipse, the major axis of

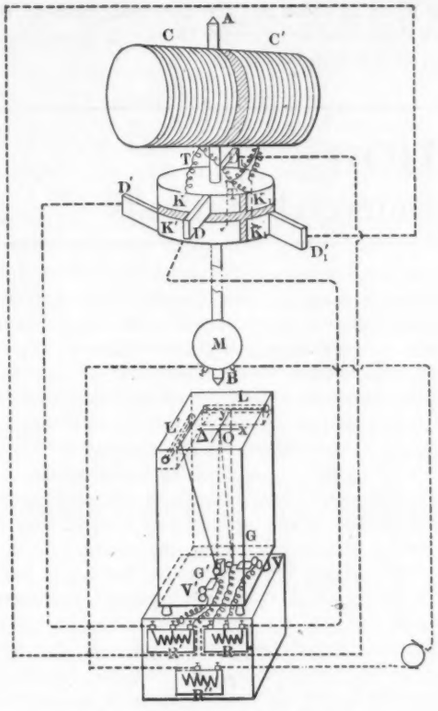


Fig. 1—Electromagnetic Compass.

which is generally inclined to the direction of motion of both the galvanometer coils. By displacing the coils *C* and *C'* with respect to the commutator, the axis may be made to coincide with one of these directions. It is then only required to add resistance to the circuit of the galvanometer, which gives the larger deflections, in order to reduce the ellipse to a circle, which would be the figure obtained if the earth's magnetic field were undisturbed by the vessel.

The tests made on board the *Patrie* go to show that below the two armored decks the maximum deviation due to the soft iron increases from the center of the ship to the fore part. The action of permanent magnetization and induction in the vertical soft iron parts likewise undergoes a constant increase (at least this was the case on the *Patrie*) in the direction toward the fore part of the vessel. By far the main portion of the disturbing magnetic fields thus seems to be due to the armor, though the presence of magnetic masses, such as torpedoes, in the neighborhood of the compass may alter considerably the directive force, and produce some sudden disturbances in an ordinary compass which is supposed to be compensated. All these disturbances are readily investigated by means of the electromagnetic compass which, as above stated, allows any compensation to be effected within a few minutes.

ELECTROLYSIS OF OIL PIPES.

By Warren H. Miller.

At Wilson's Point, Conn., the Standard Oil Company maintains a large shipping department where oil is taken from barges and sent inland to storage tanks in a yard about a mile back from the sound, from which tanks it is loaded into tank cars or pumped inland through pipe lines. For several years there had been much trouble and some fatal fires due to stray currents from an electric railroad situated in the neighborhood. Whenever connections were made between the tank boats and

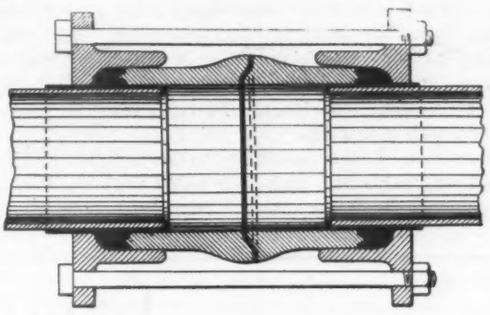


Fig. 1—Ordinary Type of Insulating Joint.

the oil pipes sparks were formed and measurements showed that the pipes were carrying several hundred amperes. A trolley line passed the inland oil yard and curved out on a long point to a picnic ground on Roton's Point. Across the bay from this point was located the oil company's loading wharves on Wilson's Point, and five pipe lines, one 8 in., two 6 in. and two 4 in. led in from this point to the yard. A large part of the return current, instead of taking the roundabout route of the railway tracks, crossed the bay and followed the pipes back to the trolley line. A barge connected to a pipe line made an excellent contact electrode with the water, and the making or breaking a pipe connection to a barge was accompanied by sparks, which often resulted disastrously.

The author was called in to attack this problem, and, after a

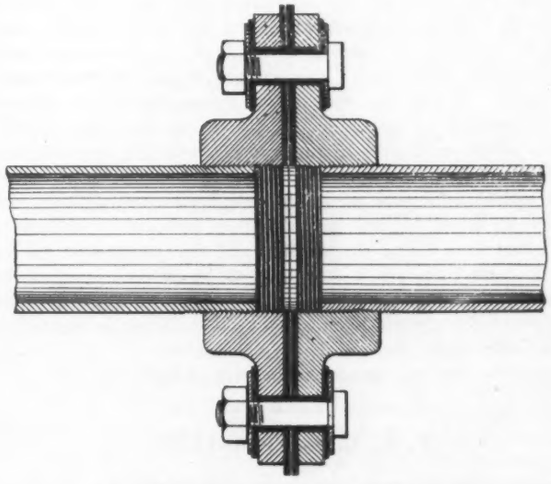


Fig. 2—Special Type of Insulating Joint.

careful study of the conditions, decided to insulate certain pipe joints and thus increase the resistance of the leakage circuit by an amount sufficient to discourage the current from taking that path.

The usual type of insulating joint, such as used on water and gas mains, was not suited for this work, as it employed rubber, which is vulcanized by the action of oil. A joint of this type is shown in Fig. 1. Furthermore, this type of joint was not strong enough for use in the oil-pipe lines, which are liable to

roll and travel sidewise under the heat of the sun, as is the case with surface oil lines.

To meet conditions here encountered the author designed and installed the joint illustrated in Fig. 2. It is made up of standard flanges drilled with bolt holes ¼ in. larger than the bolts, and bushed with ⅛-in. red fiber. This was easily accomplished with Standard Oil fittings, but if Master-Pipefitter fittings are used it would be well to employ one size larger flange, for instance, a 10-in. blank for an 8-in. pipe. The steel washers under the bolt-heads and nuts were insulated by red fiber washers and the steel ones clipped on one side to allow for the curve of the thread-boss. For gaskets the only thing that is really oil-proof is a dense black composition gasket, made in Germany under the name of "Dichtungsgaum," and sold here as Strong's oil-proof packing. This is a dielectric and comes in meter-wide sheets some 20 ft. to the roll. Two gaskets were used to each joint, ¼ in. larger all around than the flange, and tested out with a magneto.

To install it, it was necessary to select clusters of pipe couplings reasonably near each other on all five pipes so that one pipe would not shunt the others. Three such points were selected about 600 ft. apart on the line, and all the couplings were split lengthwise and pried off, giving room enough to screw on the flanges, allowing them to face up within the thickness of two 14-in. gaskets. In all four 10-in., eight 8-in. and eight 6-in. couplings were replaced with these insulating flanges, counting the set right at the wharf. The loading racks in the yard, consisting of 27 3-in. pipes were insulated in the same way as the large pipes, replacing a coupling in the swinging connecting arm. To insulate the tracks in the yard a pair of oak fishplates were put on the yard rails at the frog of the trolley crossing.

Tests of this equipment were then made and showed no currents whatever in any of the sections of the pipe line though each was negative, more or less, to the water of the bay. Everything in the yard was still positive to the trolley track, but not to the yard rails. Even in wet weather when the yard rails were more or less in connection with the trolley track there was never any chance of sparking on connecting up the tank cars to the loading pipes, as these had the insulated joints to fall back on, nor was there ever any further trouble in connecting up the steel barges at the shipping wharf.

Central Station

Management, Policies and Commercial Methods

DECISION ON INJURY FROM CONTACT WITH A TELEPHONE WIRE CROSSED WITH ELECTRIC LIGHT WIRE.

The California courts have rendered a decision in an action against a telephone company and an electric light company by a troubleman in the employ of the former company who was injured through a cross of the wires of the two companies. On the occasion which gave rise to this action, the man was making a test on certain telephone wires for the purpose of locating a ground which seemed to exist, during which he touched other telephone wires which were in contact with electric light wires belonging to the defendant electric light company, at a point where the insulation was worn off. It was shown that these telephone wires and the electric light wires were strung at a distance of about 6 in. or 8 in. from each other, instead of having 2½ ft. clearance claimed to be necessary for safety. It was also shown that a jumping arc was caused by the contact or proximity of the wires, and that it was known to the employees of the electric light company and had been reported to the foreman. The foreman, when notified, remarked that "it was up to the telephone company" to look out for its wires. It was held that both companies were guilty of negligence. Upon the question of the negligence of the electric light company it was held to be immaterial that the telephone wire was the last to be placed. With knowledge on the part of the electric light company that the wires were thus dangerously close, the continued maintainence of the wires in that position was negligence on the part of both companies.

N. E. L. A. PROGRAMS.

A prominent Western central-station manager, in a letter of appreciation of an editorial in the issue of June 2 on the N. E. L. A. programs, writes as follows: "If ever a convention meeting of the N. E. L. A. needed some mild, courteous criticism this 1910 convention must have been one. Great credit is certainly due Mr. Frueauff for his efforts in handling in such an able manner a convention which was unwieldy to say the least; but the results at St. Louis certainly prove that some radical change must be made during this coming year or the next convention will be like a world's fair, i.e., one where the man who has a limited amount of time at his disposal will have to skim around the edges and get no real benefits from his trip. I am sure if the decision for a program plan be left with the managers of central stations, a large majority would vote in favor of a much smaller number of papers, reports, etc.; also that the men who had been selected because of their fitness to take part in the discussion should receive the papers ahead of time; and then a proper allotment of time should be made for their discussion. Matters of public policy, rate regulation, central-station rates, State commissions, the attitude of the underwriters in dealing with gasoline competition, etc., are certainly matters of live importance to the central-station manager and might be of more importance to discuss in the meeting hall than matters relative to the purchasing department. I had the pleasure of satisfying my own curiosity before I left St. Louis that I was not of the minority in thinking along the above lines. If, therefore, your journal continues to take the stand, as outlined in the editorial referred to, during the present year, I am sure that when the time arrives for the next meeting the officials of the N. E. L. A. will appreciate the points so ably set forth in your article, and that you will receive the thanks of all progressive central-station managers."

HOUSE MOVER LIABLE FOR INJURIES TO UNDERGROUND ELECTRIC CABLE.

An unusual case was tried in the Supreme Court of Erie County recently. The defendant, wishing to move a house through the streets of the city of Buffalo, had obtained the consent of the plaintiff company, and the company sent out its men to remove the overhead wires. The house was moved by the use of a capstan and tackle. In so doing, workmen engaged on the job drove an iron spud or stake into the ground over the underground conduits, and so deep into the ground that it penetrated the conduits and so injured two of the cables that they were put out of commission, and it became necessary to remove the cables and replace them with others. This action was brought to recover the necessary cost incurred in replacing the cables in question, and was based upon an allegation of an unlawful trespass upon the plaintiff's property. The defendant contended he was ignorant of the location of the conduits in question, and had no knowledge that any such underground conduits were laid in this street, and that the plaintiff wholly failed to inform him of the fact; and that, if the defendant was liable at all under the

circumstances of the case, he could only be held liable on the ground of negligence, and whether he was guilty of negligence was a question of fact to be submitted to and found by the jury under proper instructions by the court. The court, however, held that, upon the evidence, the case presented was not one of negligence, but one of unlawful trespass, and directed a verdict for the plaintiff for the damage sustained. In its opinion the court said:

"The question is thus presented whether it was the duty of the plaintiff to inform the defendant of the location of its conduits or cables, or whether the law imposed the duty of ascertaining their location on the defendant. We have been cited no decisions on the question presented, and we believe that its disposition must be largely one of first impressions. We are aware of no precise authority on the subject. We are, however, of the opinion that when one like the defendant uses the public streets of a city for his own private purposes, and goes beneath the street surface by excavating or otherwise, the duty rests upon him to fully inform himself as to what lies below, so that he may avoid injury to the property of the city or others rightfully there. The streets of a modern city are so underlaid with pipes and conduits of various kinds necessary to the comfort and welfare of its citizens that one may be required to almost take judicial notice that in digging he may encounter some such pipe or conduit at any point in a street. We have sewers and water pipes, mains and laterals, steam heating pipes, gas pipes, electric lighting and power lines, telephone and telegraph wires and cables, and all with their necessary branches and connections for service of the abutting owners. When, therefore, one proposes using the public streets for his private purpose, and proposes driving iron spuds or stakes below the surface ordinary prudence and care dictate that he should inform himself as to what lies beneath, so as to avoid injury to public property, or the property of public service corporations. If he fails to do this, he drives his stakes or makes his excavations at his peril."

JAPANESE ELECTRIC LIGHT CHARGES.

By E. SAKUMA.

According to the latest returns published by the Japan Electric Society, the lowest charge made for electric light in Japan is that of the Nagano Electric Light Company, which charges not more than 17 cents per month for each 10-cp lamp burning all night, while the highest rate is that of the Tokyo Electric Light Company, which charges $1 for the same service.

COMPANIES	Charges	Motive Power	COMPANIES	Charges	Motive Power
Osaka	$0.50	Steam.	Takamatsu	.72	Steam.
Yokohama	.85	"	Fukushima	.37	Water.
Kobe	.75	"	Wakamatsu	.77	Steam.
Nagoya	.42	Water	Yokkaichi	.30	Water.
Tokyo	1.00	Water and steam.	Iyo	.35	Water.
Shizuoka	.55	Steam	Wakayama	.30	"
Tokushima	.72	Steam	Himeji	.75	Steam.
Nagasaki	.60	"	Okasaki	.35	Water.
Hakata	.70	"	Kofu	.39	"
Kyoto	.87	Water and steam.	Morioka	.27	"
Okayama	.75	Steam.	Kagoshima	.55	"
Kanazawa	.44	Water.	Onomichi	.62	Steam.
Kumamoto	.62	Steam.	Sanuki	.70	"
Niigata	.72	"	Matsumoto	.22	Water.
Hiroshima	.55	Water and steam.	Tosa	.64	Steam.
Shimonoseki	.75	Steam	Yamaguchi	.67	"
Nara	.30	Water	Kanazawa	.30	Water.
Oshima (Hokkaido)	.90	"	Akashi	.50	Steam.
Kurume	.45	Water and steam.	Nippo	.35	Water.
Hirosaki	.65	Water	Yamagata	.37	"
Toyama	.60	"	Shinano	.25	"
Tsu	.65	Steam.	Nagano	.17	"
Aomori	.42	Water	Yonezawa	.35	"
			Shingu (Kishu)	.40	"

The difference in the charges is accounted for principally by the diversity of the motive power used—water or steam—and partly by the width of streets, the construction of the houses of subscribers and the cost of laying the wires. The rates charged by the various companies of Japan for a 10-cp lamp per month are as shown in the accompanying table.

It may be noted that the Kobe Electric Light Company has recently reduced its price, the rate for a 10-cp lamp being now 55 cents with 5 cents extra for lamp and installation. For a gate lamp of the same power 42 cents is charged and for one of 5 cp 26 cents.

ELECTRICAL DISTRIBUTION OF ENERGY IN INDUSTRIAL PLANTS.

By GEO. R. TERRY.

After about a year of careful study and analysis of conditions and costs from every conceivable point of view, the following system of distribution of electric energy has been adopted for operating motors and lamps throughout several industrial mill properties consisting of large areas covered with a great variety of mill buildings ranging in size from small detached pump and acid houses to large open-floor spaces of three or four acres under one roof densely covered with manufacturing machinery requiring good general light and motors varying in size from ¼ hp to 200 hp scattered indiscriminately throughout the plant.

With large motors, each of which takes a considerable percentage of the energy transmitted over a main, separate motor service and lighting mains are undoubtedly preferable, but with many small and mixed sizes of motors, liable to removal to new locations more or less often, and which take a relatively small percentage of the energy in the mains, one system of feeders and mains for lamps and motors appears to work out to greater advantage, as any one motor is seldom large enough to cause interruption of service on the mains.

In some cases energy is generated in the plant, in others transmitted to the plant and transformed at a central point therein to the distributing voltage. High voltage circuits about the plants are avoided altogether and 440-volt, three-phase, 60-cycle distribution is used throughout, feeders running from the main switchboard to the various departments. Watt-hour meters on the switchboard record the energy transmitted over each feeder and the energy so accounted for is charged to each department. Occasionally a few lamps or a small motor in some part of the plant may be remotely located from the feeder or mains supplying the department of which it is a part. In such a case the energy is taken from the nearest feeder or main through a watt-hour meter and so properly charged to the correct department. Each feeder is protected and controlled at the board by an oil switch with overload release having inverse time-limit relays. A polyphase indicating wattmeter is mounted over each feeder switch and connected to the feeder controlled thereby. The incoming feeder, in the case of the energy being received by transmission, includes an oil breaker on the primary side of the transformer having overload release with inverse time-limit relays, the transformer secondaries being connected directly to the busbars on the switchboard. The incoming feeder panel also carries an ammeter in each leg of the circuit, a voltmeter, power-factor meter, watt-hour meter and ground detecting lamp.

When energy is generated in the mill the 440-volt generators are connected direct to the switchboard busbars through plain oil switches and the generator panels carry the same equipment as the incoming feeder panel with the addition of a field switch and rheostat control handles. The feeders are carried through buildings on the roof trusses by means of porcelain cleats, strain insulators being used at turns and ends, the cleats simply holding the conductors in line and out of contact with trusses, etc. In each department the feeders connect to a system of mains through cut-outs in iron boxes. In general, one main is run near one wall through the length of a building 50 ft. or 60 ft. wide and in buildings 100 ft. or so wide; one main is run near each side wall. All mains are run on the roof trusses in the same manner as feeders. When circuits pass through the yards from building to building they are carried on glass insulators supported on steel bents attached to the building side walls or roofs.

Motors are tapped from the nearest main through cut-outs in iron boxes, each motor circuit being run in conduit from the cut-out to compensator and motor with all live parts completely enclosed. Three-phase, squirrel-cage induction motors are used with compensators having overload and no-voltage trips, which operate to open the switch on an excessive current or failure thereof, thus doing away with separate fuses or circuit breakers in the motor circuit.

All yard and mill buildings are lighted with 250-watt tungsten lamps in spring-suspended fixtures having a 24-in. radial wave reflector, the general rule being to have the reflectors 15 ft. from the floor and the lamps equally spaced over the floor area on the basis of an energy consumption of 0.4 watt per square foot in the buildings. In the yards they are simply placed at previous arc-lamp locations, the old arc circuits being used for distributing the energy. In the buildings the lamp circuits are grouped on panel boxes on the side walls, which are connected through branch mains to the regular distributing main nearest the box. These branch mains are connected to the distributing mains through cut-outs in iron boxes, the circuit running three-phase in iron conduit to a three-phase transformer located directly over each panel box, where the voltage is reduced to 110 and delivered three-phase to three vertical busbars on the panel. The two-wire lamp circuits are connected through ferrule-type fuses to these buses and are equally divided among the three phases. The ½-in. conduit lamp circuits each connect to the panel box through a double-pole snap switch mounted on a conduit fitting just where the conduit enters the box. This allows all the circuits from a box to be controlled by a group of switches just above the box. The boxes being kept closed at all times except when renewing fuses or connecting in a new circuit. By distributing three-phase directly to the box, the balancing of the lighting load is practically automatic.

The general rule is to run all lines larger than No. 8 B. & S. open above the roof truss line and in conduit below. All circuits of No. 8 and smaller always in conduit.

The compensators mentioned for starting motors are still in the experimental stage and are not yet in universal use, but those now operating are giving good and efficient service and little remains to be done toward their further improvement.

In this class of work foolproof apparatus is of great importance and this is what has been sought for, combined with efficiency. The induction motor, automatic compensator and three-phase lighting panel boxes, with external lamp-circuit switches, and all live parts of circuits fully enclosed and inaccessible to mill hands, practically fulfills these conditions.

Careful investigations have been made to ascertain the system and voltage that would give the greatest over-all efficiency and the above system and methods of construction have been adopted as a result. Probably its most inefficient feature is the lighting transformer, but as a whole it proves to be the system costing the least to operate combined with the greatest continuity of service. It is often the case that the efficiency of some part of a distribution system is investigated and improved, but it has been the endeavor in these cases to take the whole system and every side of it, such as the cost of energy lost, of depreciation, of maintenance, of operation, of interruption to service and of interest on the investment and find that system which would yield the greatest profit year in and year out, all things considered.

In one mill building, which was illuminated by 53 enclosed multiple arcs consuming 550 watts per unit, there now are 53 250-watt tungsten units hanging just where each arc lamp hung and connected to the original arc circuit. The operators, without exception, say the building is lighted better than before the change and the current consumption is now less than one-half what it was with the lamp renewals costing less than the arc lamp maintenance. It is interesting to note that the life of the tungsten lamp has proved greatly in excess of what was expected.

Direct current is used in all these plants for crane service and electrolytic work and is obtained by the use of motor-generators.

CENTRAL-STATION RATE FACTORS.

The Railroad Commission of Wisconsin has printed in full its decision and various papers relating to the case of the Madison Gas & Electric Company, which involved the regulation of central-station rates. This document is also printed as an appendix, comprising 184 pages, of the report submitted at St. Louis by the public policy committee of the National Electric Light Association. The decision was rendered March 10, and its main points were reported in these columns in the issue of March 17. Some details compiled from the full publication and of general interest to central stations are given below.

The commission in its analysis of the rate question involved considered that the cost of rendering electric service for lamps and motors is made up of two elements, namely: (1) a fixed charge independent of the number of hours per year the consumer uses his installation; (2) an operating or variable charge dependent on the number of kw-hours used. The fixed charge is dependent on the consumer's maximum demand on the station at the time of the station peak load of the year, while the variable charge is dependent on the kw-hours as registered by meter. The commission used two methods of analysis to determine the relative amount of the fixed and variable charges, which are divided into consumer and demand charges. The consumer charges are independent of the amount of the consumer's installation and practically the same for all consumers. The demand charges are proportionate to the maximum demand which the consumer creates and the output proportionate to the kw-hours.

In one analysis which the commission makes, the total expenses of giving service amounting to $172,376.37 are divided as follows: Consumer charge, $28,952.07 (17 per cent); demand charge, $37,212.43 (21 per cent); output charge, $106,211.87 (62 per cent). Analyzing the expenses by another method somewhat less complicated, which consists simply of regarding items of the same or similar nature, such as taxes, depreciation, interest and profits as the demand expenses, and classing practically all other items as output expenses, the commission finds that the demand expenses amount to $71,864.17 (42 per cent), while the output expenses are $100,512.20 (58 per cent). This, of course, is for the entire electric service of all classes.

The lost and unaccounted-for energy for the year ending June 30, 1909, was 14.43 per cent for all classes of service, including that supplied to the street railway company. The lost and unaccounted-for being practically negligible in the case of the energy sold to the street railway, of course, brings the general average higher. The lost and unaccounted-for energy supplied to incandescent service was 20.54 per cent; that to arc service 6.68 per cent and to motor service 21.86 per cent.

The load curves of the various classes of service show that the peak load for the year 1909 occurred Dec. 21 and amounted to 2056 kw. The peak loads of the different classes of service, namely, incandescent lighting, power, arc lighting and street railway, occur at different times of the year. Had the maximum demands of all branches of the service occurred at the same time, the peak load would have been 2583 kw instead of 2056 kw. The diversity factor of the different classes was, therefore, about 1.25. That is, the maximum demand would have been 1.25 times the actual peak load had the maximum demands of the different classes of service occurred simultaneously. Of the instantaneous maximum demand or peak of the year, 67.12 per cent was for incandescent service, 6.42 per cent for arcs, 8.71 per cent for power and 17.75 per cent for the street railway.

The ratio of maximum demand to connected load is an important element in figuring rates. The commission found that

for the year ending June 30, 1909, on the alternating-current lighting system of the company, the maximum station demand was 27.23 per cent of the connected load for the direct-current motor circuits of the company, the maximum station demand was 12.74 per cent of the connected motor load.

The commission points out that there is a close relation between the maximum instantaneous peak and the company's investment. It is necessarily the highest demand that determines station capacity and more remotely the cost of buildings, accessories and distribution equipments.

The commission went very thoroughly into the matter of the relation of the connected load of consumers to the total cost of service. The decision points out that proper assessment of the variable or output cost of production is easily and equitably made by means of watt-hour meters. The distribution of fixed or demand cost, on the other hand, is a more difficult matter. Such charges are only properly apportioned when each consumer is charged for the part of the demand occasioned by him at the time of the station peak. Since such peak demands frequently shift as the company develops or fails to develop its outpeak business, a distribution of the burden of capacity cost is only fair to individual consumers when they are given compensation for economies they effect by a more diversified use of future service.

One of three methods is usually followed to determine the additional demand consumers place upon the central station. In many cities meters registering the maximum individual demand are installed. Regular readings are taken and the capacity cost assessed on the basis of the demand indicated. This method has drawbacks which seriously affect the practicability of employing it in some cities, in the opinion of the commission. It necessitates an additional expense item often out of proportion to the returns secured from the individual consumer. It gives no idea of the time the demand occurred and hence penalizes the off-peak load. It is doubtful whether it can be successfully employed with small and short-hour residence users, of which the company at Madison has an especially large number, and several companies which have been its most ardent advocates have, according to the commission, abandoned its use for this class of business.

In several cities the number of rooms have been made the basis of estimating the demand for residences. This method, again, while it has much to recommend it, does not seem suited to Madison. It fails to differentiate between the small residence illuminated almost entirely with gas, and the small electrically lighted apartment, or between the large residence and the large rooming house.

A third method frequently used is to apportion demand cost upon the total or some designated portion of the connected load.

Where uses to which all the consumers put service are similar, the total connected load is perhaps the best divisor of capacity cost, since it assumes that the relative proportion of actual demand to the total connected load is constant and does not differ considerably as between separate consumers.

Some idea of the demand placed on the central station by residence and business districts can be obtained from demand-meter readings at transformers supplying typical districts. Results obtained in this way in the city of Madison indicate to the commission that the relation of total residence demand to connected load is from 15 per cent to 20 per cent, and that the relation of total business demand to connected load is from 55 per cent to 50 per cent. The commission also recognizes that the demands at the station of the various consumer classes differ in themselves.

In Madison the average residence installation consists of 16.8 lamps. The most prevalent installation is one of 10 lamps. The average residence installation in Madison is smaller than in Manitowoc or Marinette previously investigated by the commission. The sales per lamp per year and per consumer per year for Madison were larger than for Marinette and Manitowoc.

From demand-meter readings taken by the company in Madison on several typical private houses, rooming houses and fraternities, from a close inspection of residence lighting during the peak hours, and from data gathered from four cities having extensive experience with demand meters, the commission finds that an average active or maximum load of 50 per cent of the connected load is not unfair for residences in Madison. This percentage of demand tends to decrease with the size of the installation.

As to the maximum demand of stores, data gathered from four cities in which Wright demand meters are extensively used indicates individual consumers maximum demands as ranging from 40 per cent to 100 per cent of the connected load with a prevailing ratio of 70 per cent.

For offices data furnished the commission by companies in five cities using demand meters gives the average ratio of actual demand to connected load of 57 per cent, 65 per cent, 75 per cent and 68 per cent to 87 per cent.

For restaurants the ratio of the separate consumers demands to the connected load as indicated by Wright demand-meter readings in three cities from which the commission has data ranges from 52.3 per cent to 62 per cent.

In saloons data from four cities using Wright demand meters gives an average ratio of the separate consumer's demand to the connected load of 62.6 per cent, 64 per cent to 87 per cent, 76.4 per cent and 92 per cent.

For factory lighting data gathered from three cities in which demand meters are used gives strikingly close ratios of consumer's demand to connected load, namely, 54.4 per cent, 53.5 per cent and 56 per cent.

AVERAGE HOURS PER DAY SERVICE IS IN USE.

Residences	.705
Stores, exclusive of window and sign lighting	1.590 hours
Offices	.700 "
Restaurants	3.951 "
Saloons	2.192 "
Factories	1.438 "
Churches	.478 "
Hotels	3.609 "
Clubs	1.435 "
Schools	.404 "
Laundries	2.113 "
Livery stables	2.063 "
Lodge and dance halls	.84 "
Halls of apartment and office buildings	1.785 "
Depots	2.572 "
Theaters	.974 "
Blacksmith shops	.351 "
Machine shops	.868 "
Carpenter shops	.379 "
County and Federal buildings	5.517 "
University of Wisconsin	.520 "
Power load	0.854 "

For churches the demand data from three cities relating to the consumer's demands and connected loads give ratios of 56 per cent, 85 per cent, and 81.7 per cent.

For hotels, data gathered from two cities using demand meters gives average ratios of consumer's demand to connected load of 28 per cent and 28.4 per cent.

For livery stables, data from two cities in which demand meters are used gives average ratios of consumer's demand to connected load of 52.3 per cent and 58.3 per cent.

For lodge and dance halls, data from one company using Wright demand meters with sufficient number of consumers to permit generalization indicates an average ratio of consumer's demand to connected loads of 68.6 per cent.

For depots, data furnished from two cities using demand meters place the ratio of consumer's demand to connected loads at 75 per cent and 95 per cent.

For theaters, data furnished from two cities using demand meters place the ratio of consumer's demand to connected loads for this class of service at 49 per cent and 89 per cent.

For the different classes of business in Madison, the commission found that the average hours' daily use of the total connected load for the year were as shown in the accompanying table.

Wiring and Illumination

AN AERIAL LIGHTHOUSE AT CLEVELAND.

Credit for the first aerial lighthouse in this country will probably belong to Cleveland, Ohio. The City Council is now planning to erect an electric search lantern on a tower 175 ft. high in the public square, which will mark the city's location for navigators of passing airships, as well as lake craft on Lake Erie.

SHOW-WINDOW FIRE FROM FALLING LAMP.

A fire which did no serious damage, but which was of quite unusual origin, occurred in a show window of a State Street department store in Chicago a few days ago. A 40-watt tungsten lamp was hanging in this window in the ordinary vertical position and attached to a standard fixture in the usual manner. Ten feet below it, on the floor of the window, was a mass of ladies' dress goods. In some manner the socket of the lamp suddenly broke, perhaps due to a short-circuit. The bulb fell in the textile fabric beneath and set it on fire. The contents of the window were burned or badly damaged, but the heat set in operation a sprinkler system and the fire was prevented from spreading further. The wiring leading to this lamp when afterward examined was found to be all right, and there was a 6-amp fuse in the circuit. It is rather remarkable that the bulb could drop 10 ft. through the air and still retain enough heat to set fire to the cloth beneath. It is thought that the latent heat of the glass of the bulb must have caused the fire, but the accident is an unusual one and has excited some interest among electrical men in Chicago. The exact cause of the supposed "short" in the socket is unknown.

ELECTRICALLY OPERATED MACHINE FOR CLEANING GLASSWARE.

A special machine devised and constructed under the direction of the chief electrician of the Chicago Federal Building, for washing and cleaning the 4000 glass reflectors in use in that building is shown in the accompanying illustration.

It comprises a pair of washing tanks mounted on a rubber-tired truck adapted to be wheeled anywhere about the building, and is fitted with a motor for washing, rinsing and polishing, which can be energized through a pair of flexible conductors from any convenient 220-volt outlet.

The first tank, in which the washing is done, contains soaped water in which washing powder has been dissolved. At the bottom of the tank, under a wire screen, is a ship's type propeller. The reflectors ready to be washed are piled in a wire basket which is set in the tank on top of the screen. A ½-hp, 220-volt motor, mounted at the front of the truck, drives the propeller through bevel gearing. When the lid of the tank is closed, this propeller, with the aid of vanes in the tank, serves to throw and splash the soaped water in a miniature cataract over and through the glass shades in the wire basket. The suds in the tank are kept at nearly boiling temperature (after first being filled with hot water) by means of an electric heating coil in the bottom of the tank. This coil is arranged for three different degrees of heat and when turned on full takes 3500 watts. The tank holds about 50 gal. and the basket will accommodate about 60 reflectors at a time.

After washing in the first tank for several minutes, while the operator is collecting another basketful of glassware, the reflectors are removed to the second or rinsing tank. Here the remaining suds are rinsed off and the reflectors left for a few minutes to drain, on the screen shelf at the side of the tank, their drippings falling back into the tank. The rinsing tank contains a heating coil similar to that in the washing tank, so that the glass emerging from the rinsing process is quite warm and quickly dries itself automatically in the air. The water in the second tank contains an ammonia solution which aids in giving a brilliant luster to the reflectors when they are dry.

One end of the motor shaft is fitted with a buffing wheel on which the shades are rapidly polished. Just over this buffing

Machine for Cleaning Glassware.

wheel is an electric lamp, provided so that the machine may be used in dark places or at night, when it is not desirable to light up a hallway or room.

With the machine, a basketful of reflectors can be thoroughly cleansed in three minutes, although it usually takes longer than this for the attendant to collect the next lot of shades, during which time the first basketful is allowed to wash. In its everyday use about the Federal Building at Chicago the washing machine thus enables one man to do the work formerly performed by four. It can also be used to wash incandescent lamp globes, or any other form of glassware. Mr. W. A. Richardson, chief electrician of the building, planned this machine, which in more than a year's use has thoroughly proved its practicability.

THE ILLUMINATION OF VERY LARGE, HIGH ROOMS.

The Lighting Equipment of a Large Track Room and Gymnasium.

By Jas. R. Cravath.

The new gymnasium of the Northwestern University, which has recently been completed at Evanston, Ill., has both track and gymnasium rooms, which are notable on account of their size. Their lighting called for some special study in new methods of artificial illumination. The inside dimensions of the track room are approximately 193 ft. x 129 ft., which give a 10-lap-to-the-mile running track around the wall and a 60-yd. straight course for sprints. Fig. 1 shows plans of the first floor of the gymnasium building and of the track room, and Fig. 2 is a cross-section of the track room showing the steel-trussed arch roof construction. The height of the roof at the center of the arch is 50 ft.

When plans for lighting the track room were first being considered in the fall of 1908, a suggestion offered was to hang a large number of arc lamps some distance down from the roof, as has frequently been done in lighting of coliseums and similar structures having high arched roofs of this character. However, the business manager of the Northwestern University, Mr. W. A. Dycke, who had the construction of this gymnasium

under his charge, was not satisfied with this solution of the lighting problem, as he appreciated the fact that an array of arc lamps hung low over a large area of the kind would not only detract from the architectural appearance, but would be uncomfortable to the eyes, especially when the room might be used for auditorium purposes. The track room was designed not only for all the varieties of indoor and outdoor sports which can be played in a large room of this kind, but also for occasional use as a large auditorium. Upon being assured by the writer that the use of exposed arc lamps hung low was by no means necessary or advisable for the successful and economical lighting of the track room, Mr. Dyche authorized the necessary engineering study to illuminate the track room and gymnasium according to the most modern method that could be devised. As

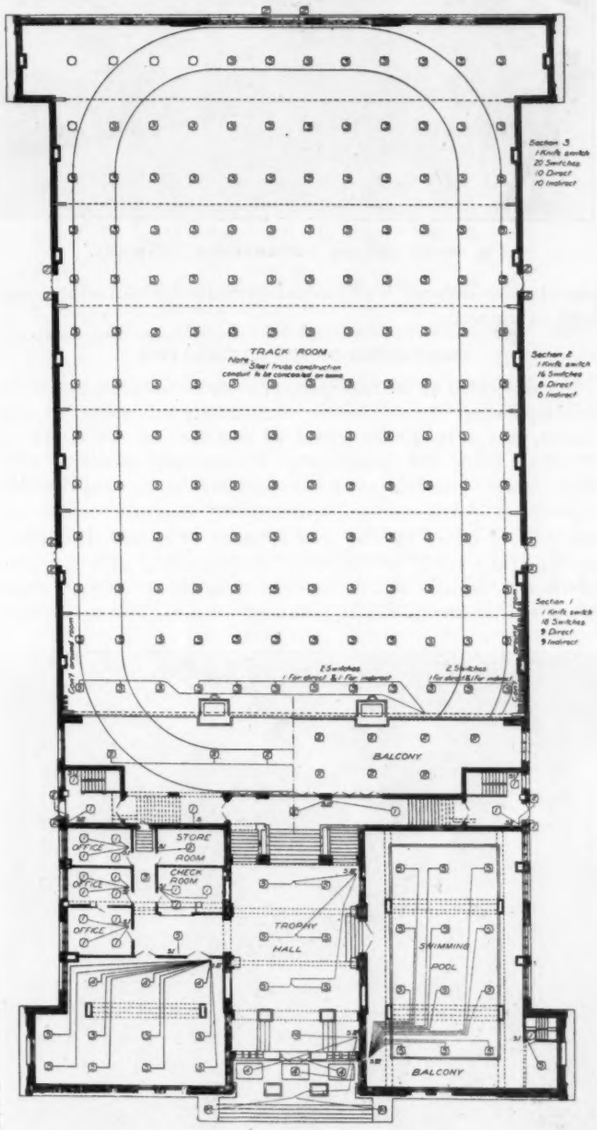


Fig. 1—First Floor Plan.

the architectural features of this building were being given more attention than buildings of this character frequently receive, it was also necessary to give considerable study to a proper combination of practical utility with architectural effects in conjunction with the architect.

From an engineering standpoint, there were two principal problems to solve. First, a considerable portion of the total flux of light of the lamps must be delivered down on the floor of the track room, even though the lamps be placed high near the roof, and this delivery must be accomplished in such a way that direct light from the lamp would not fall in the eye of a person looking across the room in any direction. Second, the ceiling and walls must be sufficiently illuminated to take off any gloomy effect, and to minimize as far as possible the effect on the eye of glare from the lamps and reflectors used. Although the writer believes that it will never be possible to play a regular game of baseball inside of a building and catch high flies as long as any direct lighting is used, it was nevertheless considered desirable to supply considerable illumination to the ceiling and walls, not only for the general effect, but in order to make it easier to follow a ball with the eye when playing any kind of ball game at night in the track room.

In order to meet the first requirements of delivering light efficiently in the lower part of the room with lamps placed at a great height (the height of the track-room roof varying from 20 ft. to 50 ft.) the use of the proper reflector was of the first importance, especially when coupled with the requirement of efficiency was the further requirement that the reflector must shade the source of light so that no direct rays from the lamps would fall in the eye of the ordinary observer.

It was decided that the tungsten incandescent lamp would be the best to use under the circumstances. Some consideration was given to the flaming-arc lamp, but the university authorities objected to the use of a lamp which would require frequent trimming and repairs of mechanism in such a location. Provisions for lowering a large number of arc lamps would also have been rather elaborate. There was also a further objection to the use of any lamp of higher candle-power than the 100-watt tungsten. In order to have the source of light properly shaded

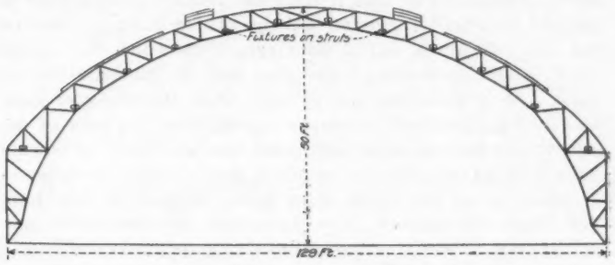


Fig. 2—Section Through Track Room.

by the reflector, it was necessary to use a reflector which would confine the light from any one lamp within a comparatively narrow angle—that is, within 30 deg. or 40 deg. of a vertical line through the lamp. Now, if one were to employ a very powerful unit like a flaming-arc lamp, it would be necessary to confine the flux of light from that lamp within such a small area on the track-room floor that an unnecessarily high intensity of illumination would be given with correspondingly unnecessary expense. To state the matter another way, it would have been necessary to use practically as many individual sources of light scattered over the area to be lighted with large lamps as with small, in order to get the proper shading and distribution at the same time.

The general plan decided upon was to use a combined direct and indirect system of lighting. For the direct lighting, use is made of 100-watt tungsten lamps, pointed downward, and equipped with a deep one-piece corrugated glass mirror reflector, designed by the writer specially for this installation. For the lighting of the ceiling, or the indirect lighting, two parabolic mirrored half-reflectors, pointed upward, were placed in the top of the fixture. Some consideration was given to a lantern design of fixture flexibly suspended from the steel arches. This was abandoned, however, in favor of the much more substantial present form, which consists of a box rigidly fastened to the steel struts which connect the steel-arched trusses. The general design and appearance of these fixtures in place can be seen in the view of the track room in Fig. 3, and also in a view of the gymnasium room, which is of similar design, in Fig. 4. It was, of course, necessary to provide for mechanical protection of

the delicate tungsten lamps when fixtures are hit by balls, as well as for artistic appearance and efficiency of light utilization.

The arrangement of the lamps and reflectors is shown in Figs. 5 and 6. The 100-watt tungsten lamp, which is placed point downward for direct lighting, for flexibility is hung on a short piece of drop cord, instead of being rigidly attached to the fixture or reflector. The sides of the box fixture are of such design that a baseball striking the side would not touch the art glass, which forms a background for the metal design. A coarse wire netting is placed across the bottom of the fixture. The reflector over the 100-watt lamp is 10¾ in. diameter by 11⅝ in. high, and consists of one piece of glass with silvered mirror, as before explained. The distribution of light from this reflector, with 100-watt, clear-bulb tungsten lamp, is shown by the curve of Fig. 7. The general shape of the reflector is indicated in Figs. 5 and 6, and is approximately that of an old-fashioned beehive.

Calculation of the total light flux obtained from the curve of Fig. 7 shows that the watts per lumen are about 0.164, with a 100-watt tungsten lamp operating at 80 mean horizontal candlepower. For the indirect lighting use was made of parabolic half reflectors of one piece of mirrored glass, suited either to 25-watt tungsten lamps or 50-watt carbon lamps. A set of 25-watt tungsten lamps were installed (without excessive breakage during installation) in the track-room fixtures in the spring of 1909, but the breakage in service was excessive and at the present time carbon lamps are in use for indirect lighting pending the production of less fragile, 25-watt tungsten lamps. These fixtures and the steel structural work are finished in verde antique. The design on these fixtures corresponds in general to other ornamental designs of the building. Behind the metal design is an art-glass pane, into which the college color, purple, is worked. The plan was to illuminate the art glass with a small amount of light from the 100-watt lamp by running a little of the mirror coating from the back of the reflector, so as to let some light shine through. However, owing to lack of proper time for installing these fixtures, in order to get them up for the North Shore Music Festival in May, 1909, this detail was omitted. For the benefit of others who may attempt similar work in the future, it may be stated that it was found that the most satisfactory way of removing the silvering so as to allow a small amount of light to go through the reflector for lighting the art glass was to pass a sharp chisel or knife down the high point of each corrugation on the reflector, thus removing the silvering from a narrow band at the top of each corrugation. By such removal of the silvering the illumination of the art glass can be accomplished with the minimum of expense. At this point the question naturally occurs whether it would not have been better to use translucent prismatic or opal reflectors which are much lower in first cost and would without modification let light through to the art glass. The answer is that they would let through too much and thus seriously reduce the useful light directed toward the floor. A very convincing practical experimental demonstration was made of this fact in some of these fixtures. On the low fixtures next to the walls translucent prismatic reflectors are used, partially for decorative effect and partially for throwing some light on the walls.

Fig. 4—Gymnasium, Northwestern University.

CALCULATION OF THE ILLUMINATION.

It was decided by the management after an inspection of some buildings where the amount of illumination was measured and known, that 3 ft-candles would be sufficient on the floors of the track room and gymnasium. It was then estimated that this average illumination could probably be secured by the expenditure of 0.9 watt per square foot. This was before the reflector for direct lighting was designed or tested. From the photometric tests of an individual reflector, Fig. 7, it was determined later that with a 100-watt tungsten lamp one lumen of useful illumination can be produced for 0.164 watt per square foot. In other words, with an expenditure of 0.164 watt per square foot an average illumination of 1 ft-candle can be produced over each square foot. Increasing this value by 25 per cent to provide a factor of safety for dirt and depreciation would bring the necessary consumption up to 0.2 watt per lumen, or 0.2 watt per square foot for each average ft-candle obtained, or for 3 ft-candles the required consumption would be 0.6 watt per square foot. By adding 0.3 watt per square foot

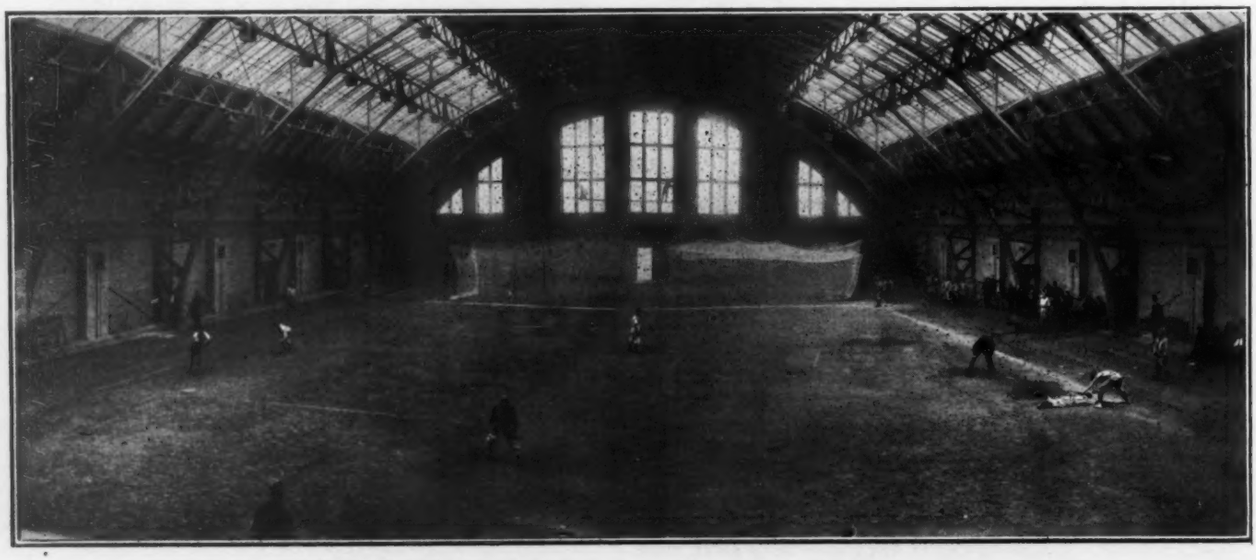


Fig. 3—View of Track Room, Showing Box Fixtures.

for indirect lighting, an additional factor of safety is secured. The original estimate was therefore on the safe side. Under the conditions of roof and ceiling in this gymnasium and considering the fact that some of the indirect lighting is necessarily thrown against a rough skylight, from which only a small per cent is reflected, it is probable that from 0.5 watt to

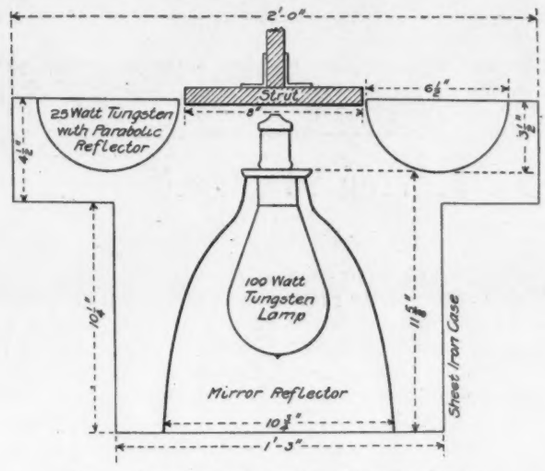


Fig. 5—Longitudinal Section Through Center.

1 watt per lumen would be required for the indirect lighting. Taking 0.75 watt per lumen as an average figure for the indirect, an expenditure of 0.3 watt per square foot for indirect lighting would add $(0.3 \div 0.75) = 0.4$ ft-candle to the direct illumination.

Having fixed upon 0.9 watt per square foot as the approximate desirable power consumption it was found convenient and desirable for architectural reasons to place two rows of fixtures between each steel arch, except between the end arches and the end walls, where only one row was needed. This meant 13 spans with 12 fixtures to each span, or 156 units of 150 watts each. This arrangement would require 23,400 watts, or somewhat more than the 22,600 watts which 0.9 watt per square foot would call for. This arrangement was adopted.

In the other rooms of the building outside of the track room and gymnasium, opal reflectors giving an extensive type of light

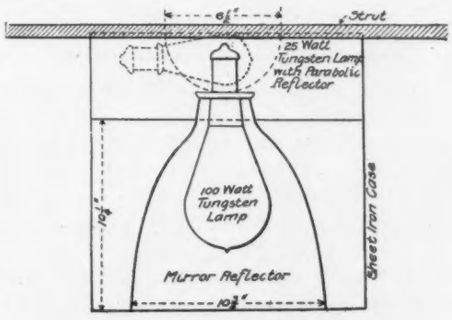


Fig. 6—Cross Section Through Center.

distribution have been employed. In the trophy room, social room and other places where the expense was justified, the reflectors were surrounded by ornamental box art-glass fixtures of a general design in keeping with those in the gymnasium and track room. In the ornamental lamp posts on the front of the building the lamps are in long rectangular art-glass box fixtures of unique design.

The results in the track room, which has now been in use some time, are said by Mr. F. O. Gillesby, director of physical training, to be very satisfactory both as to quantity and quality of illumination. Much of the time only the direct light is used. Basketball and track work are easily carried on without the light background furnished by the indirect lighting on the ceiling. Indoor baseball is played at night. The light is sufficiently confined by the reflectors to make it unnecessary to light lamps except over the portion of the room which may be in use, and hence considerable economy of operation is possible as compared to a system in which more reliance is placed on the illumination obtained from distant lamps. At the same time the reflectors do not concentrate enough light to make objectionable shadows, as have sometimes been the case where lighting has been attempted with extremely concentrating reflectors used at great height. The direct-lighting system employed undoubtedly represents the maximum efficiency obtainable with a direct-lighting system with tungsten lamps, because there is so little opportunity for absorption by ceiling and walls when the light is directed from an efficient reflector surface. The efficiency of the installation as a whole is, of course, considerably reduced by the indirect lighting when the latter is turned on. It was thought best, however, to sacrifice this much, not only for the sake of general appearance, but because it might be found necessary to have well-illuminated ceilings for playing some kinds of ball at night.

With a properly designed ceiling and a large enough interior a regular game of baseball at night should be easily possible, but conditions in this building were not favorable to pure indirect lighting, and at the time this installation was planned there had not been sufficient experience with it to justify its trial here even had conditions been more favorable.

All the wiring of the building is placed in iron-pipe conduit.

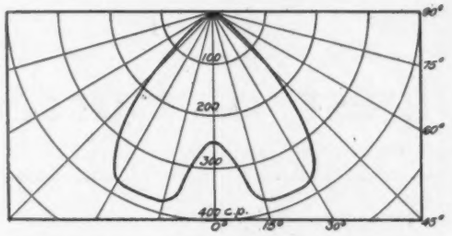


Fig. 7—Light Distribution from Reflector Used for Direct Lighting with 100-Watt Tungsten Lamp.

Control of the track-room circuits is obtained at a combined switch and cut-out cabinet shown at the right in Fig. 3 on one of the steel arches. The main switch to this cut-out cabinet is reached through the bottom door. Above this are placed the cut-out fuses. In the top are the flush push switches, the push buttons of these switches being connected through a solid brass plate with all circuits labeled and numbered. The circuits for the direct and indirect lighting are kept separate.

The building cost approximately $200,000, and is a fine example of solid construction and good architecture throughout. It is the gift of Mr. Jas. A. Patten. The erection was under the management of Mr. Wm. A. Dyche, business manager of Northwestern University. The architect was Mr. Geo. W. Maher, of Chicago. Henry Newgard & Company were the contractors for the electric wiring, the National X-Ray Reflector Company, of Chicago furnished the reflectors, and the Willy Lau Company, Chicago, made the fixtures.

NEW TELEPHONE PATENTS.

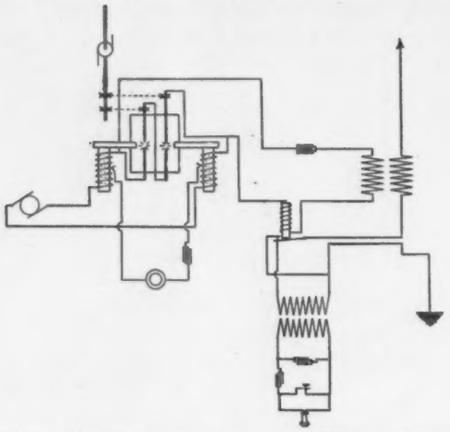
POCKET MOUTHPIECE.

A pocket mouthpiece has been patented by Anna Bebout, of St. Louis. This has the general appearance of a hunting watch case. When both covers are thrown open, a protecting diaphragm partition is exposed. The rim of the case is also designed to fit over the lip of the usual transmitter mouthpiece, and an internal flange is provided so that the device will fit sufficiently tightly over more than one size of mouthpiece.

TRANSMITTING APPARATUS FOR WIRELESS SYSTEMS.

One of the problems of wireless telephony lies in the necessity of impressing the electric telephone currents upon the antenna with negligible distortion. Several different methods have been

tried, one of these being by the use of an electric arc. The transmitting circuit of Mr. V. H. Laughter, of Detroit, uses this means; in this case the arc is exposed to a magnetic field varying with the telephone waves. The currents passing



Laughter Wireless Telephone Transmitting Apparatus.

through the arcs, for there are two of them in series, also pass through the solenoids which generate the magnetic field to which the arcs are exposed. The secondary of the telephone transmitting circuit, which secondary includes a condenser, is shunted across the arcs, the connection being through adjustable contacts, as shown in the illustration. It is found that an adjustment of field, arc and transmitter circuit can be obtained such that the arc is normally quiet or inactive, and agitation of the transmitter will make it active. The secondary of the antenna transformer includes a condenser and relay. This circuit is impervious to the arc operating currents, but not to the superimposed telephone currents generated in the active arc. These currents excite the antenna through the transformer and simultaneously cause the relay to cut out the receiving circuit and ground the antenna circuit.

Letter to the Editor.

Alloy for Electrical Instruments.

To the Editor of Electrical World:

Sir:—In view of the great interest manifested in light castings for aeroplanes, automobiles, etc., it should interest your readers to know that English patent No. 22,073, granted Oct. 13, 1903, to F. W. Green and T. Prescott, covers alloys consisting of 70 to 90 parts aluminum, 18 to 5 parts magnesium and 12 to 2 parts cadmium, which alloy is recommended and used instead of electroplated ware and for ornamental work, electrical instruments, carriage fittings, bells, gongs, castings, etc.

New York. C. W. Leavitt.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Determination of Efficiency of Direct-Current Machines.—C. B. Drysdale.—The author refers to the usually unsatisfactory statement in text-books of Kapp's modifications of Hopkinson's test for determining the efficiency of direct-current machines. The author describes a method of carrying out the tests, which "seems fairly satisfactory, although not pre-

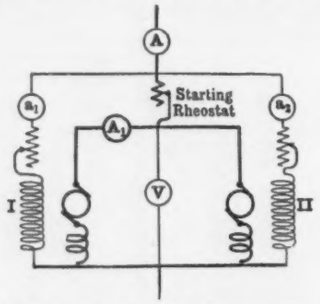


Fig. 1—Diagram of Connections.

tending to be theoretically correct." Fig. 1 shows the method of connecting up. The regulation of the currents is effected by the rheostats in the shunt field circuit in the ordinary manner. If the excitation of machine I is weakened so that it becomes the motor evidently the motor input $= (A_1 + a_1)\,V$, and the generator output $= (A_1 - A + a_1)\,V$. On the other hand, if II is made the motor, by weakening its excitation, the motor input $= (A_1 + A - a_1)\,V$, and the generator output $= (A_1 - a_1)\,V$. The difference between the input and output in either case is AV, the total losses in the two machines. Thus far the equations are rigidly correct. If the machines are of fairly high efficiency it does not require a great change of speed or excitation to produce the circulating current between the machines, and one may assume the iron and frictional losses as nearly constant and equal for each machine. If, then, there be subtracted the value A_0V the watts when the machines are both running under equal conditions or at "no load," from the value of AV when running under any given load, the excess is approximately the sum of the I^2R losses in the armature of the two machines. The current in the armature of machine I is A_1, and in that of machine II is $A_2 = A_1 - A + a_1 - a_2$. Hence one may divide the above copper loss, $(A - A_0)\,V$, in the ratios of the squares of the armature currents and the copper loss in I is $\frac{A_1^2}{A_1^2 + A_2^2}(A - A_0)V$, and in II it is $\frac{A_2^2}{A_1^2 + A_2^2}(A - A_0)V$, which are determined without measuring the armature resistances. The loss in each machine is then taken as half the iron and friction loss, or $\frac{A_0V}{2}$ together with its own share of the copper loss as above obtained. One thus obtains the motor output-generator input, and thence can calculate the efficiency of each machine separately, and plot its curve of efficiency against output. Efficiency curves illustrating the method are added.—Lond. *Electrician*, June 3.

Aluminum for Commutators.—A. V. Clayton.—Some notes on the use of aluminum for the commutator of a machine which was built some time ago. The bars were made from drawn aluminum, and although the metal was very soft, there was practically no wear observable on it, as particles of the carbon brushes seemed to become imbedded in the soft aluminum and prevented its rapid wearing away. It ran quite sparklessly, and without any cleaning. The chief trouble in using the aluminum bars was the difficulty in making connections between the copper conductors on the armature and the commutator bars. These were made by wedging the copper conductor into a slot milled in the segment and the fusion of aluminum at the joint by means of a blow-pipe. If the commercial manufacture on a large scale of such machines had been taken up, screwed or other mechanical connections would have been necessary. However, the use of aluminum for commutators and other purposes had to be dropped because of the very large commercial copper interests which were at work against the employment of aluminum, and hence this one trial machine having an aluminum commutator was the only one made. In the case of commutators the lower conductivity of aluminum is

of little importance, the brush area and the cooling surface being the determining factors as to size, and it does not seem that the oxide surface film offers any objections.—Lond. *Elec. Eng'ing*, June 2.

Braking Induction Motors.—While the braking of direct-current motors can be carried out quickly by operating them as generators, it is necessary with induction motors to brake them by external means. A method of electric braking devised by A. Héreng is to replace, at the moment of braking, the rotary magnetic field of the induction motor by a stationary field produced from some artificial source of direct current. This stationary field generates eddy currents in the rotor and these oppose the movement of the motor and brake it quickly. One method of carrying this out is shown in the left-hand diagram of Fig. 2, where *a* is the three-phase squirrel-cage induc-

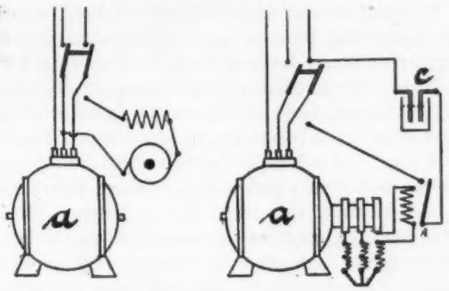


Fig. 2—Braking Induction Motors.

tion motor to be braked and is provided with a small series motor placed on its axle. So long as the induction motor *a* is in regular operation the circuit of the direct-current series motor is open. At the moment of braking the induction motor, the circuit of the direct-current motor is closed over two phases of the induction motor. Since it acts only for a short moment, its capacity may be small. A different arrangement is shown in the right-hand diagram of Fig. 2, in which an induction motor with slip rings is braked with the aid of direct current derived from an electrolytic aluminum rectifier *c*.—*L'Industrie Elec.*, May 25.

Stray Fields.—J. REZERMAN.—A mathematical paper supplementing his former paper on stray-field reactance in which the author had introduced certain coefficients which varied according to the types of windings. In the present paper he analyzes this point more in detail and shows the corrections which must be applied in order to make the formulas general. —*La Lumière Elec.*, May 28.

Currents in the Bearings of Machines.—L. ADLER.—An English translation of his recent German paper in which the author discusses the causes which lead to the presence of currents in the bearings of electric machines, and proceeds to show how the injurious effect of the same depends on the current density and bearing surface. Lastly, he discusses means whereby this nuisance can be avoided.—Lond. *Electrician*, June 3.

Generators Driven by Steam Turbines.—E. BOULARDET.—An illustrated article analyzing the special features of alternators for direct drive by steam turbines.—*La Revue Elec.*, May 30.

Lamps and Lighting.

Illumination Tests.—J. SUMEC AND L. BLOCH.—J. Sumec criticises some points in the proposed rules of the committee on illumination of the Verbund deutscher Elektrotechniker. This committee had proposed to measure the mean horizontal illumination in a street at height of 1 m above the ground. He thinks that it should be measured directly on the ground itself. Bloch replies that this would be exceedingly difficult with present photometers and besides the difference between the two measurements is too small to justify taking such trouble. Sumec stated further that in addition to the mean illumination of the horizontal surface, the maximum and the minimum illumination should also be given. He thinks that the maximum illumination is of no account; the only thing that is wanted is the minimum illumination since the mean illumination measures the strength and the minimum illumination measures the quality of the lighting. He, therefore, suggests the omission of the specification of the maximum illumination and to define the uniformity (gleichmässigkeit) of illumination as the ratio of minimum to mean illumination. Bloch replies that whether the minimum illumination or the mean illumination is of greater importance for judging the quality of a lighting system in a street, can only be determined for each individual case. In side streets the minimum value of illumination is often more important than the mean illumination. He thinks it would be a mistake to neglect the maximum illumination altogether.—*Elek. Zeit.*, June 2.

Indirect Illumination.—B. MONASCH.—At the recent general meeting of the Verbund deutscher Elektrotechniker the author presented a paper in which he showed that high candle-power tungsten lamps are suitable for indirect illumination and are far more economical in this respect than pure carbon arc lamps used on alternating-current circuits. On the other hand, on direct-current circuits the two systems of indirect illumination by means of high candle-power tungsten lamps and by means of arc lamps with the carbon in the ordinary position entail about the same cost of operation. However, with arc lamps in which the usual position of the two electrodes is reversed, the arc-lamp system is more economical than the tungsten-lamp system when the price of energy is more than 0.75 cent per kw-hour. Nevertheless, the author thinks that even in such cases the tungsten lamp should be preferred for its other advantages, such as lack of noise, lack of smell, and the better color of the light.—*Elek. Zeit.*, June 2.

Reduction in the Price of Tantalum Lamps.—In England the price of tantalum lamps has been reduced as follows: The discounts, terms of contracts, etc., will remain exactly as hitherto, but the new list price of the popular 16-cp lamp designed for from 100 volts to 120 volts is now reduced to 50 cents, to which price the 50-volt to 130-volt 25-cp, the 60-volt to 130-volt 32-cp, and the 100-volt to 130-volt 50-cp lamps have also come down. The 50-volt to 80-volt 10-cp lamp is still cheaper at 37 cents, to which value the price of all 20-volt to 40-volt lamps have also been reduced. The 200-volt to 250-volt 50-cp lamp has been reduced to 75 cents. The above prices are for standard bulbs. Spherical bulbs are, as a rule, 6 cents higher in price.—Lond. *Elec. Eng'ing*, June 2.

Generation, Transmission and Distribution.

Steam Turbine in Brussels.—The extra traffic arising in consequence of the international exhibition, which is being held now in Brussels, has made an extension to the generating plant a necessity, and it has been decided in view of the increase in connections to extend considerably the output of the station. The equipment consists of five four-cylinder tandem-compound reciprocating steam engines of the horizontal type, each driving a 1500-kw alternator. The most economical load of four of these, however, is only 1000 kw, and as the maximum demand for power before the opening of the exhibition sometimes amounted to 6600 kw, additional equipment was urgently required. After considerable discussion, it was decided to install a 4000-kw turbo-alternator and the machine was recently set to work. The normal speed of the turbine is 1500 r.p.m., which is high for the output rating, and hence the machine is relatively small. There are seven nozzles, all of which are automatically opened and closed by means of the governor, being mounted on a vertical spindle, which is raised or depressed with the governor sleeve. On this vertical spindle are projections which, as the spindle descends, force the horizontal nozzle valve spindles to move inward and thus to open the nozzles in pairs as the load increases. The speed of the machine can be raised by hand by increasing the pressure on the governor balls, and the same operation can be performed from the switchboard through a small electric motor which operates the same hand-wheel. There is an automatic stop which shuts off steam from the turbine when the speed reaches 1660 r.p.m. The working pressure at the stop valve is 9 atmospheres (10 at the boilers), and the temperature of the steam is 325 deg. C. The overload range is 5000 kw for one hour, and the steam consumption is

13.7 lb. per kw-hour at normal load, against a guarantee of 13.8 lb. The existing steam engines take 14.3 lb. per kw-hour and there is already a daily saving of about 5 tons of coal, which has caused the directors to consider the question of replacing the reciprocating engines by another turbine. The turbine runs excellently in parallel with the reciprocating engines. Lond. *Electrician*, June 3.

Electricity in Printing.—An article by F. Broadbent, on electricity in the printing office, discussing the advantage of individual electric drive, switch gear and the grouping of machines. While it appears to be the general view that all machines requiring, say, less than 2 hp, should be grouped on a lineshaft, there are cases when it would be better to drive individually machines even smaller than this. Under some conditions even stitching and sewing machines may with advantage be driven individually. In other articles illustrated descriptions are given of the electric equipment of Edward Llyod's, a large London publishing house, and of the electric equipment of the *Country Life* printing office in London; also on the use of electricity in a book-binding works; the use of mercury-vapor lamps in printing shops, special electric machinery for printing shops, and an electric system of printing-press control.—Lond. *Elec. Rev.*, June 3.

Installations, Systems and Appliances.

Automatic Protective Switchgear.—E. B. Wedmore.—A paper on leakage protective devices, read before the (Brit.) Inst. of Mining Engineers. In the author's arrangement there are series transformers in each phase lead, but one trip coil is transferred from the usual position into a return circuit common to the three transformers. This coil operates only on faults to earth, as there is then a resultant current in the common circuit, and the other two operate with overloads or faults between phases. Independent adjustment for operation on faults and overload is obtained. With a sensitive relay, similarity of the three transformers is necessary because if their ratios were to differ, say on a momentary overload, there would be produced in the relay a current representing a spurious leak. This current is kept within the limits by the use of a trip coil shunted by a low-resistance fuse, as indicated in Fig. 3. This fuse prevents

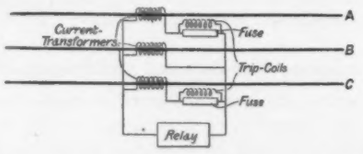


Fig. 3—Diagram of Automatic Protective Switchgear Circuits.

the trip coil from operating until an overload of sufficient magnitude has lasted sufficient time to melt the fuse, when the coil instantly takes the current and trips the switch. When relays are employed the oil switches are operated by trip coils excited preferably independently of the alternating-current supply. Where individual motor circuits are equipped with a low-voltage release, this may be utilized for the purpose, the relay short-circuiting the winding. A resistor is used in series. The author proposes to use such leakage devices in series on the main feeder, on every branch feeder, and again on each motor or group of motors. In this case, some discriminating arrangement is necessary, or a leak on any one motor will affect all the devices. This arrangement may be obtained by grading the settings of the devices; thus, on a 3000-volt circuit a 100-amp feeder may be equipped with a relay operating at 10 amp; the switch controlling a branch circuit carrying 25 amp may be set to open on a leak of 1.5 amp, and an individual motor of, say, 30 hp may have an automatic switch operating at 0.25 amp. The tests show that even in the rare event of sudden and extensive damage to a cable, discriminating action can be obtained in some measure. The author concludes that leakage is the principal source of danger in mines, and that this danger may be reduced to a minimum if a thoroughly armored and well-earthed system be employed. In this case leakage currents will be confined to the metallic covering, thus removing all risks except those arising from actual rupture of, or severe arcing in, the cable. With the author's system, even when a grounded neutral is employed, the supply should not be disturbed except at and beyond the point where the fault exists. The majority of faults develop, in the first instance, as faults to earth, whether arising from moisture, electrolysis, abrasion, or from any external cause. In the past where the neutral has been grounded, it has been necessary to employ a connection capable of passing sufficient current to operate the overload device with the heaviest setting on the largest feeder. Where leakage relays are employed, however, it is possible to employ in the earth connection a resistor which limits the leakage current under the severest conditions to a fraction of normal load.—Lond. *Elec. Eng'ing*, June 2.

Electrical Engineering in Germany.—G. Goerges.—An abstract of his presidential address at the recent annual meeting of the Verbund deutscher Elektrotechnicker, in which he reviewed briefly the present condition of electrical engineering and referred to the increased use of electricity for heating and in electric furnace industries, and to the increase in the rating of dynamo-electric machines and transformers, which has now reached from 10,000 kva to 14,000 kva. For the transmission of energy over long distances the permissible maximum voltage is limited only by the brush discharge, but this limit has not yet been reached at 110,000 volts. Storage batteries are now being used to greater extent in alternating-current as well as in direct-current systems. The development of chief interest in electrical engineering in Germany is at present the erection of transmission plants in agricultural districts. In this respect new legislation concerning right-of-way is needed. With respect to the voltage regulation and the reversal of the direction of rotation of machines, the problem is to overcome the magnetic inertia of the machines. There are now being built direct-current motors of about 10,000 hp for reversing rolling mills, which can be changed in about five seconds from the maximum speed in one direction to the minimum speed in the other direction. The author also referred to developments in the construction of induction regulators, single-phase and polyphase commutator machines and electric traction on trunk railroads. With respect to electric lighting, he referred to the increased use of metallic-filament lamps and of arc lamps without regulating mechanisms.—*Elek. Zeit.*, June 2.

High-Tension Switchgear.—A. G. Collins.—A paper read before the Glasgow Technical College Scientific Society. The author discusses recent practice in switchgear design and illustrates typical installations. In connection with switch construction he describes a hand-operated, non-automatic, three-pole oil switch. Instruments and the protection of circuits are also referred to.—Lond. *Electrician*, June 3.

Electricity in Drainage System.—An illustrated account of the electrical features included in the immense drainage scheme and sewage disposal works recently laid down by the Glasgow Corporation. Among the features of interest are electric pumping, an electric supply station and special electrical plant for clearing the catchpit.—Lond. *Electrician*, June 3.

Wires, Wiring and Conduits.

Standardization of Fuses.—H. W. Kefford.—The conclusion of his paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. After pointing out the desirability of standardization, the author gives particulars of tests on a number of representative types of fuses for currents up to 50 amp, and discusses the ratio between the rated current and the normal fusing current. He then considers the general regulations for the construction and operation of standard fuses and describes a non-interchangeable fuse system. He refers to the testing of fuses, and finally makes the following suggestions as the basis of a specification for standard fuses: 1. (a) As to the material for fuse wire, the fuse wire must not corrode or permanently change its conductivity or physical structure. (b) As to non-interchangeability, fuses up to 50 amp rated current should be provided with a simple arrangement by means of which the rating of the fuse which can be inserted by a non-technical user is restricted within definite limits. (c) To

facilitate compliance with (a) and (b) above and generally to render standardization practicable and useful, an enclosed cartridge type of fuse is recommended. (d) All fuses must be provided with a simple means for detecting fusion merely by inspection of the fitting. 2. (e) As to rating, it is proposed that the rated current marked on the fuse shall bear a definite relation to the limiting current, or least current which will produce fusion within four hours. The minimum value of the ratio of limiting current to rated current shall be 1.54 and the maximum value shall be not higher than 30 per cent above the minimum. In a correctly proportioned line of fuses this ratio should decrease from the maximum to the minimum values specified as the size of the fuse rating increases from the lowest to the highest. This regulation is based on the assumption that silver is the best metal for fusible links, taking into consideration its permanent character, the small volume required and its "clean" action when breaking the circuit. (f) As to sluggishness of action and time element, it is proposed that standard fuses shall be so rated and constructed that when loaded with 50 per cent above the limiting current they will fuse within one minute. The actual time required for fusion shall be taken as a measure of the "time-element" of the fuse. (g) Every fuse shall be clearly marked with its rated current and the maximum voltage for which it is suitable. The standard rated currents and voltages suggested are as follows: Maximum e.m.f., 250 volts—2 amp, 4 amp, 6 amp and 10 amp. Maximum e.m.f. 500 volts—2 amp, 4 amp, 6 amp, 10 amp, 15 amp, 20 amp, 30 amp, 40 amp and 50 amp. 3. (h) As to temperature rise, it is specified that when loaded continuously with 80 per cent of the limiting current no exposed part of any fuse fitting shall attain a temperature exceeding 100 deg. C. above that of the atmosphere. (k) Fuse fittings shall be tested for insulation between terminals with the fusible portion removed and between the live parts and "earth" with the fusible portion in place. (l) Fuses shall be tested for satisfactory operation on overload and short-circuit in accordance with the specified arrangements for carrying out such tests.—Lond. *Electrician*, June 3.

High-Tension Cables.—M. HOECHSTAEDTER.—The conclusion of his long illustrated serial on the dielectric properties of modern high-tension cables, with reference to the use of cables for e.m.fs. above 20,000 volts. The author continues his discussion of the dielectric energy loss in different types of cables and gives details of heavily insulated cable types, up to effective e.m.fs. of 70,000 volts, between conductor and lead armor, corresponding to 120,000 volts between phases for three-phase current. The author finally discusses the points of view which must be taken into account as to the use of very high voltages in cables, and compares especially the relative advantages of three single-phase cables and a three-phase cable for three-phase transmission of 15,000 kw at 50,000 volts over a distance of 50 km (30 miles). The two cables are about equivalent electrically. Two points are emphasized: First, that the dielectric hysteresis loss cannot be neglected in comparison with the copper loss. (In the above comparison the dielectric hysteresis loss in the three single-phase cables is less than one-half the dielectric loss in the three-phase cable. The capacity is also smaller by 40 per cent.) Second. the use of cables for such high voltages does not seem to introduce any danger for regular operation when the cable is properly dimensioned, especially if the frequency is low. However, long cables are impracticable with small copper cross-sections and for the transmission of small amounts of power on account of both the charging current and the dielectric loss.—*Elek. Zeit.*, June 2.

Insulating Material.—A note on a recent British patent (12,424, 1909; May 26, 1910) of M. Wildermann. An ebonite capable of resisting the action of chlorine and alkalis is manufactured by mixing the rubber and sulphur with from 5 per cent to 15 per cent of graphite, finely divided mica or carbon. The mixture is finally over-vulcanized.—Lond. *Elec. Eng'ing*, June 2.

Electrophysics and Magnetism.

Coherers.—W. H. ECCLES.—A paper in which a method of investigating detectors is developed with special reference to the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector as direct current to the circuit of the indicating instrument. The stream of energy supplied to the detector was always of the same order as that used in telegraphy. The detector under examination was placed in a circuit containing suitable inductance and capacity, which was secondary to a primary circuit. The primary could be set into electrical vibration by breaking a known current in it. The coupling was very weak, so that when a current of a few milliamperes was broken in the primary, the energy delivered to the detector was of the order of a thousandth of an erg, and the e.m.f. at the coherer terminals was of the order of a tenth of a volt. The response of the detector was measured by comparing the sound in its telephone with the sound produced in the same telephone by interrupting a measurable direct current. A special switch key enabled the comparison to be made quickly. The power delivered to the detector and to the telephone was determined by extrapolation from measurements on stronger currents with the thermogalvanometer. The results of experiments on coherers made of oxidized iron-wire dipping into mercury, and on coherers made of clean iron point touching an oxidized iron plate are exhibited as curves connecting (1) the steadily applied e.m.f. and consequent current through the coherer; (2) the steadily applied e.m.f. and the power given to the telephone for various rates of delivery of vibration energy to the detector; (3) the power delivered to the detector and the power passed to the telephone, the e.m.f. applied to the coherer being constant. Curves (1) show that in a self-restoring coherer the current increases more and more rapidly as the e.m.f. is raised, till, in general, a point of inflection is reached and then the current increases more slowly. Curves (2) show the rise and fall of sensitiveness to oscillations as the applied e.m.f. is increased. Curves (3) show that if W represents the power in watts delivered to the coherer and w the power passed to the telephone circuit, then $w = m(W - a)$, where m and a have values settled by the magnitude of the current through the detector. The quantity m for a good low-resistance iron-mercury coherer has been found to be as high as 0.06; while a is usually near 1.0×10^{-5} watt. The curves show that these coherers are not "voltage-operated" detectors, but "energy-operated" detectors. The author puts forward the hypothesis that the properties of an oxide coherer may arise solely from the temperature variations caused in the minute mass of oxide at the contact by the electrical oscillations and by the applied e.m.f.—*Phil. Mag.*, June.

Secondary Homogeneous X Radiation.—J. C. CHAPMAN AND S. H. PIPER.—All bodies while exposed to Roentgen radiation emit secondary rays. The secondary rays are of two types, a scattered radiation and a homogeneous radiation. As to the production of the homogeneous radiation the hypothesis has been offered that the homogeneous X radiation may be produced as the result of the sudden alteration in velocity of an ejected electron, or again, it may be due to the subsequent bombardment of other atoms by the ejected electron, the radiation taking place either from the colliding electron or from the atom struck. The authors describe an experiment which seems to prove that it is not the atom which is bombarded that emits the homogeneous radiation. It rather seems that the atom from which the electron is ejected is the seat of production of the radiation. As the result of the loss of an electron the atomic system will have to adjust itself, and in so doing the electron may vibrate with an emission of the homogeneous secondary radiation.—*Phil Mag.*, June.

Radium D and E.—G. N. ANTONOFF.—An account of an experimental investigation of radium D and its products of transformation. Radium E has a period of 5.0 days and follows directly after radium D without any intermediate product. The absorption curve for the beta rays from radium E is exponential with a coefficient of 43 cm^{-1}. The time period of radium D is about 16.5 days. Polonium and radium E can be completely separated from radium and radium D.—*Phil. Mag.*, June.

Uranium X.—F. SODDY AND A. S. RUSSELL.—An account of

an investigation which shows that the beta and gamma rays of uranium X decay at exactly equal rates, the value of the coefficient of decay being 0.0282 reciprocal day.—*Phil. Mag.*, June.

Direct Current from Alternating Current.—K. Lichtenecker.—If a true sinusoidal e.m.f. is impressed on a circuit of varying resistance, the resulting current will have a direct current component. The author calculates the amplitude of the direct-current component produced.—*Phys. Zeit.*, June 1.

Electrochemistry and Batteries.

Temperature Coefficient of Lead Storage Batteries.—A. Ferrung.—The author has investigated the change of amp-hour rating and watt-hour rating of the lead storage battery between 15 deg. C. and 48 deg. C. The relation between the "capacity" Q_t at the temperature t deg. C. and the "capacity" Q_{25} at the temperature 25 deg. C. is

$$Q_t = Q_{25}\,[1 + \alpha\,(t-25) + \beta\,(t-25)^2],$$

where β and α are the temperature coefficients relative to amp-hour efficiency. For the watt-hour efficiency the relation is the same, but the coefficients are different being γ and δ instead of α and β. The numerical values of the coefficients are as follows:

Discharge, Amperes	Temperature Coefficients			
	α	β	γ	δ
81.8	0.00485	0.000205	0.00482	0.000202
256	0.00901	0.000301	0.0102	0.000347
520	0.01436	0.0003025	0.0145	0.000218

The three discharge rates of 81.8 amp, 256 amp and 520 amp correspond to a duration of discharge in 23, 6 and 2.25 hours, respectively.—*La Revue Elec.*, May 30.

Storage Battery.—An account of the Tem and Sirius storage batteries shown at the exposition in Brussels. For Tem's batteries for use in automobiles the following figures of energy per mass and energy per volume are given: 51.9 watt-hours per kg. for a discharge at the rate of 2.185 watts per kg.; 39.9 watt-hours per kg. for a discharge at the rate of 8.29 watts per kg.; 131.7 watt-hours per cu. dm. for a discharge at the rate of 5.54 watts per cu. dm., and 101.2 watt-hours per cu. dm. for a discharge at the rate of 21.0 watts per cu. dcm. Data are also given on batteries for submarine boats.—*La Revue Elec.*, May 30.

Electric Furnaces in the Iron and Steel Industry.—G. Hooghwinkel.—A paper read before the Sheffield Society of Engineers and Metallurgists. The author refers to specifications used in Germany for better rail steel and gives the results of tests of electric steel rails. Other applications of the electric furnace in the iron and steel industry are for the production of castings, special steels and ferro-alloys. A comparison of different types of electric steel furnaces is given. Finally the reduction of iron ore in the electric furnace is briefly discussed.—Lond. *Electrician*, June 3.

Units, Measurements and Instruments.

Determining the Properties of Electric Oscillation Circuits by Zero Methods.—L. Kann.—A description of a method for determining the frequency, damping coefficient and other properties of electric oscillation circuits by means of zero methods. The principle is shown in Fig. 4. The apparatus consists essentially of two globes K_1 and K_2 of equal dimensions. They are connected by a capillary tube k. Each of the globes K_1 and K_2 contains two hot wires h_1 and h_1' and h_2 and h_2'. A little alcohol within the capillary tube k indicates a difference of atmospheric pressure within the two globes K_1 and K_2. To remove such a difference of pressure at desire, another capillary tube is inserted between s and s containing a valve H. By means of this valve H it is also possible to evacuate the two globes K_1 and K_2 whereby the sensitiveness of the instrument is increased. I and II are two circuits which are so arranged as to influence each other very little. Their alternating-current impedances are very high compared with their ohmic resistances, and therefore also with those of the hot wires. The oscillation circuit J_1, which is to be tested, produces by induction in I the current i_1. In the same way, there is an induction between II and the comparison circuit J_2, which is coupled to J_1 as shown. The current i_2 is produced by induction in J_2. The current in h_2 is i_1, in h_2' it is i_2, in h_1 it is $i_1 + i_2$, in h_1' it is zero. If the hot wires are carefully adjusted, the heat supplied to the gas in K_2 is proportional to $i_2^2 + i_2^2$, that in K_2 is proportional to $(i_1 + i_2)^2$. The difference between these heat quantities and the corresponding difference of pressures is, therefore, proportional to

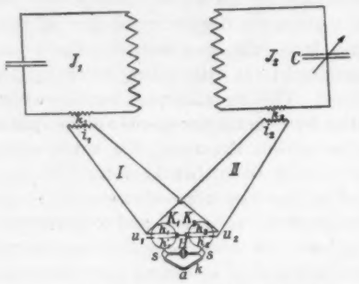


Fig. 4—Diagram of Arrangement for Detecting Properties of Oscillation Circuits.

$i_1 i_2$. This pressure difference is measured by the deflection of the small body of alcohol a within the capillary tube k. If now the adjustable condenser C of the comparison circuit is so regulated that the deflection of a in the capillary tube is zero, then the wave-length of the circuit J_1 equals the known wave-length in the comparison circuit J_2. In the same way it is possible to determine the self-induction and capacity of J_1 with the greatest accuracy. A simple modification of the method for determining the damping coefficient is also described.—*Phys. Zeit.*, June 1.

Measuring High Potentials.—C. E. Guye and A. Tschernivski.—An abstract of a paper read before the French Academy of Sciences, recommending the use of compressed gas in an electrometer for high-voltage measurements. The advantage is that not only are the brush discharge and the electric effluvium suppressed, but the parts of the instrument which attract each other can be placed nearer together without producing an electric discharge. It is thus possible to get a stronger attraction between them and a higher sensitiveness of the instrument. When the gas pressure is high enough to prevent electric discharges it is not necessary to measure the pressure since the constant of the instrument is approximately independent of the pressure of the gas.—*L'Industrie Elec.*, May 25.

Highly Sensitive Selenium Cells.—F. C. Brown.—The author endeavors to improve the sensitiveness of selenium cells by using a special mixture of the amorphous and crystalline modifications of selenium. Sensitiveness is defined as the ratio of the conductivity in light to the conductivity in dark. The highest sensitiveness was obtained by mixing 10 parts of amorphous selenium with one part of the red crystalline modification and by heating in an electric stove at a temperature of 170 deg. C. for several hours. The cells were permitted to cool within two hours. The sensitiveness of these cells varied between 30 to 1 and 300 to 1, but only one cell had the latter value and it had it only at a temperature of 3 deg. C. The resistance and sensitiveness of this cell at different temperatures are given in the following table:

Temperature in deg. C.	Resistance in Ohm	Sensitiveness
20	0.5×10^{10}	100:1
39	1.1×10^{10}	80:1
10	4.0×10^{9}	170:1
3	3.3×10^{9}	300:1

The author doubts whether this cell has more than a theoretical interest, especially on account of its very high resistance.—*Phys. Zeit.*, June 1.

Selenium.—F. C. Brown.—The author has produced a new

modification of selenium, the resistance of which increases when subjected to light—which is just the contrary to the ordinary behavior of selenium cells. The conductivity of this new modification of selenium is more than a million times that of selenium in the ordinary selenium cell. As is true with the ordinary selenium cell, the resistivity of the new modification decreases with increasing temperature. The new modification of selenium is very unstable and therefore very difficult to produce.—*Phys. Zeit.*, June 1.

Acrometer.—J. REYVAL.—In an article on the recent exposition of instruments held by the French Physical Society, a description is given of the acrometer, which indicates the maximum pressure in an internal-combustion motor at normal operation. It is of special use in central stations.—*La Lumière Elec.*, May 28.

Oscillograph.—C. DEGUISNE.—A description of a method for plotting directly the curve of a magnetic flux by means of an oscillograph.—*Phys. Zeit.*, June 1.

Telegraphy, Telephony and Signals.

Submarine Cables.—A note on a recent British patent (7791, 1909; May 26, 1910) of R. K. Gray. For the purpose of increasing the self-inductance and reducing the capacity of submarine telegraph or telephone cables, the conductor is formed of wires of two different metals, one of which is magnetic. Thus a solid central copper ore is braided with two sets of strands of copper and iron, respectively, the two sets being interlaced and insulated from one another.—Lond. *Elec. Eng'ing*, June 2.

Telephone Relay.—C. F. MONCKTON.—Some illustrated notes on the use of the S. G. Brown telephone relay in a receiving wireless telegraph circuit with different arrangements of the connections.—Lond. *Elec. Eng'ing*, June 2.

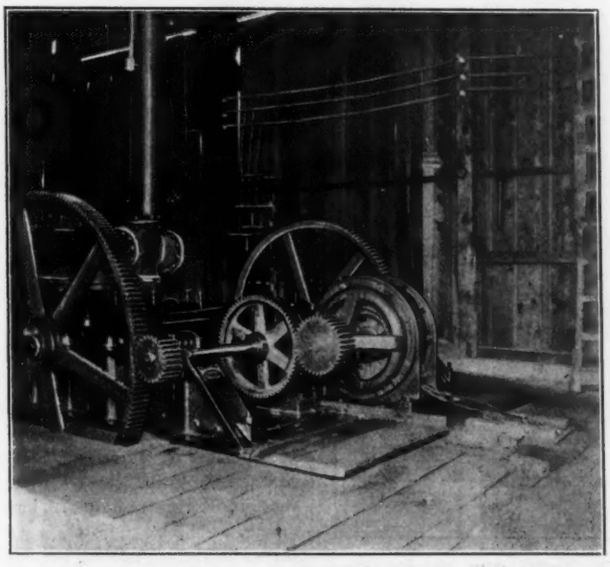
Miscellaneous.

Convention of German Association of Electrical Engineers.—An account of the recent annual convention of the German Association of Electrical Engineers held in Brunswick from May 25 to 28. The presidential address by Goerges dealt with the present condition of the electrical industry in Germany (see abstract above). The secretary stated that the number of members was 4715, and the assets of the association amounted to $37,575. Professor Behrens presented a lecture on art and engineering. Other papers dealt with the use of electricity in agriculture, papers on the subject being presented by H. Wallem, A. Vietze and R. Meier. Dr. L. Lichtenstein reported on recent progress in the manufacture of high-tension cables. In the cable factory of the Siemens-Schuckert Company tests were made of the losses in the armor of single-phase cables and of the dielectric hysteresis losses for e.m.fs. up to 70,000 volts. A table of permissible current for armored three-conductor cables buried in ground with a thickness of 17 m insulation for an e.m.f. of from 50,000 volts to 60,000 volts was also given. W. Weicker discussed tests of high-tension overhead insulators with respect to electric discharges. Dr. B. Monasch spoke on indirect illumination by means of high-candle-power tungsten lamps (see abstract above). E. Wagmüller reported on new automatic switches and speed meters, Dr. Wasmus on high-frequency instruments for medical use, Prof. R. Hundhausen on his new system of non-interchangeable fuses, and Dr. R. van Cauwenberghe on commutator motors.—*Elek. Zeit.*, June 2.

New Apparatus and Appliances

RAWHIDE PINIONS ON VIBRATING METAL-TO-METAL GEAR DRIVES.

Rawhide pinions are usually considered merely as a means of stopping noise on medium and high-speed drives, and by far the largest percentage of them are used for that purpose. It



Pump Geared to Induction Motor.

is a matter of engineering experience, however, that rawhide is beneficial on gear drives where there is vibration from irregular load, etc. An instance of this is the application of rawhide pinions to a 1750-gal. quintuplex pump in the power plant of the Parral Power & Reduction Company, Parral, Chihuahua, Mexico. This pump, as shown in the illustration, is geared through double reduction to an induction motor and furnishes the circulating water for the condenser.

Originally this pump was driven entirely by cut-steel pinions and cast-iron gears. The pump was of so light a pattern that there was considerable spring in both shaft and frame, the result being constant annoyance from broken gear teeth, while in addition to gear renewals, there was quite an expense due to the power loss of running the engines non-condensing while pump repairs were being made. The chief engineer had about decided to abandon the pump and replace it with another of different design, when the use of rawhide pinions was suggested. Accordingly, four "New Process" pinions, made by the New Process Raw Hide Company, of Syracuse, N. Y., were substituted for the four steel pinions. Two of these are shown in the photograph, one on the motor and the other meshing with big gear at the left. The other two are on the other side of the motor and placed symmetrically to those shown. These rawhide pinions were put into service over two years ago and there has not been a moment's trouble with the gearing since. In fact, the pump has been out of service only long enough to repack the plungers and replace the rubber valves.

PROTECTOR FOR GUY ANCHORS.

W. N. Matthew & Brother, St. Louis, Mo., have brought out a protector for use with the 5-in., 6-in and 7-in guy anchors manufactured by them. The protector consists of a reinforced concrete sleeve, which slips over the end of the rod, and is securely fastened thereto by means of liquid cement or grout. The purpose of the protector is to do away with the trouble caused by the corrosion of rods at the point where they come out of the ground.

TECHNICAL ADVERTISING.

Speaking on the subject "Conviction in Advertising," Mr. J. J. Rockwell, manager of the special service department of the McGraw Publishing Company, delivered a thoughtful address to the members of the Electric Club of Chicago on June 15. He dwelt on the necessity of being earnest in conducting advertising. Advertising is not a game or a gamble; it is a real commercial influence. It has been objected that advertising is intangible, but so are thoughts, and thoughts are the greatest influence in the world. Mr. Rockwell pointed out the difference between the general and various special fields of advertising. Different methods are required to meet the different conditions encountered in the general field and in special fields. The cost of educating the prospective buyer is in direct proportion to the money involved in the purchase of the article advertised.

The technical field is one of the special fields of advertising, and the speaker devoted considerable attention to it. Here it is more difficult to trace the direct connection between the advertisement and the sale than is the case in general advertising. The technical advertiser should study the subject of advertising his particular machine or appliance with care and thoroughness. There is no magic to make technical advertising a success. Keeping everlastingly at it wins. Time is a great factor, perhaps the greatest factor, in this class of advertising, and, as has been said, time respects only what time has built. The advertiser must bring himself to a conviction that advertising is a real power in business life. If he will give time, attention and study to this very important subject; if he will do all things thoughtfully in advertising as he does in other departments of his business; if he will not allow himself to be stampeded, he will be a strong and successful advertiser.

Before the discussion was begun, there was a novel series of introductions, suggested by President F. P. Vose, who was in the chair. Every man present, except the speaker of the day, arose in his place at the tables and introduced his right-hand neighbor. In many cases this introduction was accompanied by a pleasant word or two in addition.

Mr. A. A. Gray, general manager of the Electrical Review Publishing Company, was called on to open the discussion. He spoke of the growth and development of the publishing business in the technical field, and commented on the fact that the publishers of to-day are obtaining the services of high-class men with ideas to serve the technical industries. Technical advertising is now conducted on enlightened lines, and is scientifically executed, befitting the industries served.

Mr. Frederick J. Selden of the Rumford Company declared that it is the duty of the man who must pay the bill to do something. The seller and the advertising man cannot do everything in consummating a sale, no matter how keen and intelligent they may be.

Mr. A. O. Kuehmsted, president of the Gregory Electric Company, spoke of the particular advertising requirements of his own business. Here the advertising effort is confined to those who have use for the class of machinery which the advertiser has for sale. Mr. Kuehmsted attributed much of the success of his company to constant advertising. It is not so much direct inquiries and immediate results that are expected, but it is found that if a man wants the kind of machinery that this company has for sale, the advertising will cause him to bear the company in mind when the occasion arises. The speaker believes that technical manufacturers and dealers should advertise as heavily as the financial condition of the business will warrant. The success of such a business depends on the character of goods sold, the prices, and the advertising.

Mr. Frank L. Perry dwelt on the evolution of advertising and the great improvement witnessed in this method of publicity since he first became acquainted with it. Advertising, he remarked, is a business of subtleties, and he spoke briefly of the subtle influences of advertisements on those who read them; an impression may be created that will bear fruit long afterward.

Mr. J. R. Cravath urged that the specific features of the article advertised be pointed out in the advertisement; generalities are of very little use in technical advertising.

Mr. Francis Raymond spoke briefly on the relation of the cost of a manufactured article to the amount spent in advertising it; the proportion of selling cost devoted to advertising must be liberal if the manufacturer expects to make a successful campaign.

SPRING CONDUIT FOR INTERIOR WIRING.

As is well known, in all rigid conduit systems there is danger of damaging the insulation of wires when drawing them through the ducts, particularly if there are many sharp bends and elbows. In the conduit system illustrated herewith, and manufactured by the Key Engineering Company, Ltd., 4 Queen Victoria Street, London, E. C., England, the wires are laid in the conduit and not drawn in. This, of course, necessarily restricts the duct to exposed work. As shown in Fig. 1, the conduit is divided into two sections, each of which is slightly greater than a semi-circle. The bottom section, or trough A, is supported from the wall, ceiling or other structure on a small bracket C, secured or nailed to the support, and is held temporarily in position by special spring clips, one of which is shown in Fig. 5. The wires are then placed in the trough, the fittings having been previously connected at the points required. The other conduit section, or cover B, is then sprung over the trough, the combined sections constituting a complete circle of conduit. Then the spring clip D is sprung over the whole, thus rigidly holding the sections together.

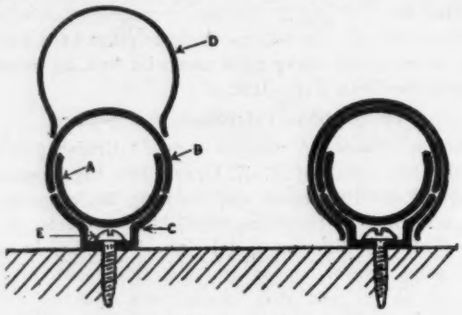


Fig. 1—Cross-Sections of Spring Conduit.

All fittings are attached to the system by means of standard nipples to steel clips, which are sprung directly on the conduit at any point. If it is desired to alter the position of a fitting, a short length of the cover is removed and the fitting is shifted to the position required A special key is provided for pulling the cover off. This key is sprung over the conduit and the free ends engage the edges of the cover when a slight depression of the handle pries one end of the cover off. In order to show that a fitting which may be so easily sprung into position and so easily removed is not liable to slide out of position, two 56-lb. weights were supported from a standard key fitting, as shown in Fig. 4. As shown in the engraving, the entire weight is carried by the grip on the conduit of the spring clip, which is about 3 in. long, to which the lamp holder is attached through a standard nipple. For pendant fittings, where the weight to be carried is likely to be greater and where the pull is at right angles to the conduit, a special fitting, consisting of a semi-circular porcelain base fitted with brass terminal

Fig. 2—Rivetting Bonding Piece to End of Conduit

plates, is supplied. These terminals are also protected by a porcelain cover of somewhat similar cross-section to that of the base. The base and cover are enclosed between the two halves of a T-shaped steel clip, the straight-through portions of which are placed over the conduit. These half clips, which meet in the center and do not overlap, are securely held together by a bayonet joint steel cap.

In order to insure electrical continuity, the lengths of conduit

Fig. 3—Wiring a Spring Bracket Fitting.

are interconnected by means of copper rivets expanded in a bonding piece. A simple screw punch is slipped over the end of the conduit, and a single turn of this screw cuts a clean hole in the exact position required to take the rivet in the bonding piece. Fig. 2 shows a bonding piece being riveted to the end of a length of pipe. The adjoining length of the conduit is shown with its newly punched hole leaning against the wall. This length is in turn riveted to the end of the bonding piece shown protruding from the riveting tool. The latter is practically identical with the punching tool, the principal difference being that the screw of the punching tool terminates in a punch, whereas that of the riveting tool has a flat head. The pressure of this flat head on the copper rivets, coupled with its twisting action, produces smooth heads on these rivets and at the same time expands them in the holes, thereby making an efficient mechanical and electrical connection.

Fig. 4—Weights on Spring Fitting.

Fig. 5—Spring Bend on a Corner.

Inasmuch as the conductors are laid in the conduit, and not drawn in, no pull boxes are necessary. Bends and tees are constructed on the same principle as the conduit, that is to say, they are built up of circular steel sections which are sprung together. A spring bend is shown in Fig. 5. These bends are supplied with the division of the sections either in the same plane as the bend or at right angles to this plane. The conduit on reaching the ceiling can therefore be continued at any angle across the ceiling, the circular section of the conduit permitting the bend to be twisted in practically any direction.

One advantage of the system illustrated is that fittings may be wired on the bench before the wires are placed in the conduit. Fig. 3 shows a wireman in the act of attaching a bracket lamp holder to a spring fitting. The special clips which hold the inner section to the bracket also suffice to keep the wires in the trough until they are secured by permanent clips. The construction obviates the accumulation of condensation, and also enables the interior surface to be so thoroughly enameled as to prevent the formation of rust in excessively damp situations.

SMALL TESTING INSTRUMENTS.

The Roller-Smith Company, of New York, has brought out a line of small voltmeters and ammeters designed with special reference to the requirements of contractors and maintenance men, which combines compactness, accuracy and ability to withstand rough usage. The mechanisms are of the improved D'Arsonval type employed in more expensive standard portable instruments, and, as with them, the staffs which carry the sapphire jewels in which the pivots of the moving element rest are resiliently mounted. This structure, which has shown such good results under the severe conditions of vibration and jar encountered in electric vehicle practice, is particularly valuable in an all-around testing instrument, which must withstand its full share of shocks when carried in a bag with other tools. The indications of the instrument are dead beat, and the scales are equally divided. The mechanisms are mounted in metal cases, the bases being of black enameled aluminum, and the cap of a similarly enameled sheet metal. A sheet of impregnated fiber is secured to the bottom face of the base plate, and serves both as an insulator and as a means of protection against acids or corrosive sprays. The cord terminals which are shown attached to the instrument in the illustration are intended principally for use when testing potentials of individual storage cells on electric automobiles. The metal of the prongs projecting from the handle is sufficiently ductile to permit of bending to a spacing which corresponds with the standard lug to lug distance, and once so set the device forms a means of taking readings rapidly. The instrument measures 4 in. x 4¼ in. x 2¼ in. The average weight is 36 oz. The voltmeters are built for ranges from 1.5 volts to 300 volts, and the ammeters from 1 amp to 75 amp.

Small Testing Instruments.

AVERAGING INSTRUMENT FOR CIRCULAR CHART RECORDS.

The Bristol Company, of Waterbury, Conn., is placing on the market a device for quickly determining the average of the record made on circular recording charts, and the integral value for the whole 24 hours, or for the time covered by the record. The device is based upon a fundamental plan as worked out by Prof. W. F. Durand, of Stanford University, and is constructed in accordance with a design due to Wm. H. Bristol, president of the Bristol Company.

The instrument can be applied for averaging records of any kind on circular charts having uniform graduations, as, for instance, records of watts, amperes, temperature, pressure, etc. Recording instruments equipped with circular charts are therefore made available for a number of applications for which it was previously thought necessary to use the instruments recording on straight lines or strip record charts. Recording differential pressure gages are coming into use for measuring velocities and volumes of liquids, air or gas flowing in mains, and this integrating device will prove of value for quickly obtaining total volumes of flow for any given period of time.

Averaging Instrument for Circular Chart Records.

The simple construction of the instrument is shown in the accompanying illustration. A wooden base with a metal socket is provided for supporting and centering the chart. The socket holds a rotatable pin with a vertical slot at the top to receive the bar which carries the integrating tracer point and triangular support. The vertical groove in the rotatable pin allows the integrating wheel to roll on the chart with uniform pressure due to its own weight.

The integrating wheel is 6 in. in diameter, the rim being graduated into 100 numbered equal spaces, and is fitted with a vernier, which makes it possible to read easily with the naked eye to one-tenth of one division on the integrating wheel. The wheel is of such large size that it is not necessary to supply any counting device for the number of revolutions. The number of complete revolutions cannot be more than two, even for a record of maximum size on the large 12-in. charts. To operate the instrument the thumb and forefinger of one hand are applied to the base of the triangular support, which is moved radially, so as to cause the tracer point to continually follow the record curve, while the chart is turned with the other hand.

By referring to a line plotted on a sheet of cross-section paper furnished with the instrument, for the particular record curve that is to be measured, the total reading for the entire 24 hours may be taken off directly.

A full explanation of the theory upon which the operation of the instrument depends has been given by Professor Durand in a paper presented at the New York meeting of the American Society of Mechanical Engineers in 1908. This may be briefly summarized as follows:

In applying the instrument it is necessary to have a uniform radial scale, from which it follows that equal increments in the length of the radius correspond to equal increments in the watts, amperes, temperature or whatever quantity is measured. The integrating wheel being carried at right angles to a shaft passing through the center does not turn and give a reading when the tracing point is moved on a straight radial line; but if the tracing point is made to follow a record, the integrating wheel will revolve and the amount of the revolution will correspond to the total of the circumferential elemental components of the record curve, the radial elemental components of the record having no turning effect on the integrating wheel. As the lengths of the arcs of concentric circles for given angles or for the entire circumference are proportional to their radii, it is evident that the amount of turning of the integrating wheel, and the reading obtained thereon, will be proportional to the average radius of the record traced.

The instrument is adapted for integrating charts with either straight or curved radial time arcs. The correction necessary for radial time arcs which are curved may be made, after completely tracing the record, by returning the tracing point to a point on the chart having the same radius as the starting point, the movement of the tracing point being along an arc corresponding to the curved radial time arcs.

ELECTRIC DRIVEN WASHING MACHINE WITH RECIPROCATING DRIVE.

A new motor-driven washing machine, the mechanical feature of which is the improved reciprocating drive of the washer drum, is shown in the accompanying illustration. This machine has been designed to require less water, and consequently less soap, than other standard washers, and the manufacturers declare that it will not wear or tear clothing or even the most delicate fabrics.

The close-fitting construction of the washer cylinder prevents the escape of heat and steam from the revolving drum, so that the water cools very slowly. The three-section cylinder enables the operator thoroughly to cleanse all parts of the machine without removing the washer mechanism. As the picture shows, the motor is arranged to drive, through a belt, a shaft which communicates motion by means of a chain to the gear mechanism operating the wringer and washer cylinder. Especially ingenious reciprocating mechanism has been provided for reversing the washer cylinder. The "New Imperial" washer above described is made by the Imperial Manufacturing Company, Independence, Kan.

Motor-Driven Washing Machine.

Industrial and Commercial News

THE WEEK IN TRADE.

IRREGULARITY was again the marked characteristic of trade conditions last week. Business in almost every line is quiet, although there were some evidences of improvement in the West and some increase in distribution. Crop weather reports were more favorable, and the agricultural sections were more hopeful. The retailers, however, report very little improvement, and declare that buyers are extremely conservative. Most consumers are taking only what is absolutely needed for immediate service. On this account the retailers are loath to lay in any extensive stocks, and jobbers and wholesalers are receiving few orders. The entire business of the country seems to be in a waiting state. There is a widespread feeling of uncertainty that prevents any sort of expansion or branching out. In the industrial world conditions are not as favorable as they were earlier in the spring. It is estimated that 25 per cent of the cotton looms and spindles are now idle. Summer sales of cotton goods have not been up to the average, and lower prices have offered very little inducement to buyers. The woolen trade is also in bad shape, owing to the high cost of raw material and the difficulty of maintaining high prices for the finished product. The production of pig-iron continues to outrun the consumption and prices are weak. Many of the iron and steel industries have been compelled to curtail their activities, and in a number of sections workmen have been laid off. There is still a moderately good buying of cars and rolling stock, but orders for rails and other equipment are very light. Building materials are still selling fairly well, but not with the same vigor as earlier in the spring. Bank clearings all over the country were somewhat reduced last week, indicating the lessening of trade. Commodity prices for the most part have been lowered during the week, although meat and provisions were advanced. Export trade is somewhat better, but is still very considerably hampered by high prices. Building trades continue fairly active. The lumber market, except in the far Northwest, is distinctly quieter. Collections are only fair, and wholesalers are somewhat annoyed on this account. Business failures for the week ended June 16 were 178 as compared with 189 the previous week, 213 in the same week in 1909, 254 in 1908, 165 in 1907 and 173 in 1906.

THE COPPER MARKET.

DOMESTIC consumers of copper during the past week purchased about 10,000,000 lb. of electrolytic for July, August and September delivery. The prices ranged between 12⅜ cents and 12½ cents. These purchases, together with some smaller purchases of other grades of copper, did much to strengthen the market during the week in tone, although prices were very little better than they have been heretofore. Export sales during the week were also much heavier than during any recent week previously, and will probably amount to as much as was taken by the domestic consumers.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	12.00	12.20	.....
June	12.00	12.20	12.10
July	12.00	12.20	12.10
August	12.00	12.20	12.10
September	.....	.....	.....

The London market June 20 was as follows:

	Noon. £ s. d.	Close. £ s. d.
Standard copper, spot	55 1 3	55 0 0
Standard copper, futures	55 15 0	55 13 9

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	12.05c
London, spot	£62 0 0	£54 2 6
London, futures	65 18 9	54 17 6
Best selected	65 10 0	59 0 0

Standard copper in London has shown considerable recovery in tone, and some strengthening in price. This has persuaded local dealers for the foreign market to buy more freely. Whether these purchases were brought about by speculative considerations or not is hard to say. The actual consumption of copper seems very little better than it has been at any time within the last two months. From a statistical standpoint the developments in copper are all as yet in favor of the consumer. Production continues to be as heavy as ever, and, with the exception of the sales above mentioned, the takings have not been noteworthy. There seems to be little doubt that at the end of the month report of the Copper Producers' Association will show further accumulations, in spite of this little flurry of buying. In the meantime the selling agencies and producers are industrious in circulating optimistic reports, and apparently seem confident that consumption will shortly overtake the output. There is no evidence of any intention, however, to curtail the present rate of production. Exports for the month, including June 20, were 11,694 tons. The daily call on the Metal Exchange June 20 quoted standard copper as per the accompanying table.

INDUSTRIAL AND COMMERCIAL NOTES.

Pennsylvania Water & Power Company.—Reports have been published in Baltimore and Philadelphia papers to the effect that the Consolidated Gas, Electric Light & Power Company, of Baltimore, had passed into the control of the Pennsylvania Water & Power Company. Charles E. E. Clark, vice-president of the Pennsylvania Water & Power Company, denies that any such deal has been consummated or is pending. He says that his company does not intend to go into the business of serving private consumers. Its transmission line between Baltimore and the McCall Ferry dam will soon be completed, and the substation in Baltimore is almost ready for the installation of machinery. It is expected that the plant will be able to deliver energy in August. Arrangements have been made with the Consolidated company for the purchase of practically all the power that the Pennsylvania Water & Power Company will transmit to Baltimore. With regard to the further market of the company, Mr. Clark said that negotiations were pending for reaching Harrisburg, and that several other cities within a radius of 40 miles would probably be served. He said that he had no doubt there was ample market for all of the power his company would be able to generate.

Westinghouse Lamp Company Increase.—The Westinghouse Lamp Company, which is the lamp department of the Westinghouse Electric & Manufacturing Company, is preparing to reopen its factory on West Twenty-third Street, New York City, which has been closed since July, 1908. A complete outfit of modern machinery and facilities for the manufacture of 10,000 tungsten lamps per day are being installed, and it is expected that the factory will be ready for use in August. Advertisements are already being published in order to secure sufficient help to put the plant in operation. This reopening is mentioned in the annual report of the Westinghouse Electric & Manufacturing Company as one of the evidences of increased business. The report also refers to an addition of 22 per cent in the floor space of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company. It also says that plans are being matured for increasing the facilities of the R. D. Nuttall Company.

General Electric Company Gives Up Copper Smelter.—The Forestry Department of the Government has taken steps to close down the General Electric Company's big copper smelter at Bully Hill, Cal., July 1. That the plant will close is admitted by officials of the company. Recently this property has been producing only about 150 tons a month, although its former output reached as high as 500 tons per month. The General Electric Company has expended about $3,000,000 in the Bully Hill property.

Atlanta Hydroelectric Power Company.—Plans have been completed by the newly organized Atlanta Hydroelectric Power Company, referred to in our issue of May 5, for financing the project. The company proposes to construct a dam 700 ft. in length across the Tugaloo River, where it is estimated that 25,000 hp can be developed. Transmission lines will be run to Atlanta and to other towns in that section.

Flaming Arc Lamps in Yonkers.—The Business Men's Association of Yonkers has arranged for the illumination of one block of New Main Street with 12 Excello arc lamps. These lamps will be purchased by the Yonkers Electric Light & Power Company, but the bills for energy will be paid by the Business Men's Association, which is a similar arrangement to the one made in Newark.

Gregory Electric Company Sales.—The Gregory Electric Company, of Chicago, reports unusually good business both for export and domestic shipment. Among its recent shipments are: a carload of electrical machinery and engines to Sasga & Company, Tokyo, Japan; a 40-kw General Electric generator and other equipment for Angarita & Company, San Cristobal, Venezuela; two carloads of three-phase induction motors to the Cleveland Worsted Mills; a carload of three-phase motors and 500-volt generators to Wright & Sweeney, Tacoma, Washington; a carload of 220-volt direct-current motors to Hart-Parr Company, Charles City, Iowa; a carload of direct-current, 220-volt motors to Hicks Locomotive & Car Works, Chicago Heights; a carload of 220-volt National direct-current motors to the Pacific Cooperage Company, San Francisco; a 300-kw General Electric alternator to the Helena Gas Company, Helena, Ark.; a 120-kw directly-connected generator and engine to W. H. Labb, Houghton, Mich.; a 200-kw, 440-volt, two-phase Westinghouse generator to the Winters & Prophet Canning Company, Mount Morris, N. Y., and a 200-kw General Electric three-phase alternator to the Tiffin Electric Company, Tiffin, Ohio. The company has also just made some very heavy purchases of machinery, including a lot of 220-volt direct-current motors in the plant of the Cadillac Automobile Company, Detroit; a large lot of 110-volt, direct-current motors, which were operating in the New York shops of the Western Electric Company; the entire stock of new National direct-current motors left in the factory of the National Brake & Electric Company, Milwaukee, and all of the 220-volt direct-current motors in the plant of the Crane Company, Chicago. The company reports that many inquiries are being received from manufacturers interested in the purchase of motors, and declares the demand for immediate delivery to be unprecedented.

Competition in Baltimore.—Richard B. Fentress, of Norfolk, to whom the so-called Fentress-Medairy franchise was granted which permits the company to distribute electric current in Baltimore City, is organizing a company to finance an electric plant which, it is said, will be capable of supplying the people of Baltimore at a lower rate than they are now paying. Other companies which have endeavored to secure a franchise to compete with the Consolidated Gas, Electric Light & Power Company have failed, the City Council refusing to entertain the idea. But, by availing himself of this new ordinance, Mr. Fentress makes possible the operation of a company without the necessity of going before the City Council to secure a new franchise. It is understood that if V. G. Bloede, who has tried on several occasions to secure a franchise in Baltimore, should finally secure the privilege, Mr. Fentress will negotiate to take over the property, thereby causing the electric business to be divided between but two companies. The Patapsco Electric & Manufacturing Company, of which Mr. Bloede is the head, is supplying energy in the counties and is partly operating under the Fentress-Medairy franchise.

City Island Monorail Line.—Bion L. Burrows, president of the company which is building the new monorail line between Bartow Station on the New Haven Railroad and City Island, says that while it may not be possible to open the first section of his road on July 4, as he had hoped to do, he feels certain that cars will be running some time during the month. The construction work has been somewhat delayed by the continuous rainy weather. All of the grading has been completed and the road is being ballasted. A portion of the superstructure has also been built, and the guide rails and feed wires are being put into place. Only that portion of the road is being constructed now from Bartow to the bridge between Pelham Bay Park and City Island; the section running through the streets of City Island will not be built until later. Mr. Burrows says that on the section that will be completed in July, although it is only about 7000 ft. long, he expects to be able to show a speed of 80 miles an hour. Two cars will be ready for service as soon as the line is completed. It is felt that these will be sufficient to test the practicability of the system.

Extensive Electric Vehicle Publicity Campaign.—The Electric Storage Battery Company has secured the co-operation of central-station companies throughout the country and the leading electric vehicle manufacturers for the purpose of conducting an extensive combination campaign, utilizing for this purpose pages and double pages in the leading monthly and weekly magazines and periodicals. The company has found that the central stations have awakened to what the electric vehicle means to them in the sale of current, while the electric vehicle manufacturers, although large advertisers of their own product, also realize the advantage to be gained by flooding the public with a general publicity exploiting the electric automobile in an educational way and graphically laying before hundreds of thousands of readers every week just why it is supreme as a city and suburban car and, for commercial purposes, practical and economical.

Allis-Chalmers Company Gas Engines.—The Allis-Chalmers Company has secured from the United States Steel Corporation additional orders for six gas-engine-driven electrical units, which will increase the corporation's generating equipment at Gary, Ind., by 25 per cent. The 25 engines which the Allis-Chalmers Company has installed in this plant, and the order just secured, will make a total of thirty-one gas engines with a combined rating of 150,000 hp, which will be the largest power plant of its kind in the world. These units will operate on blast furnace gas. In addition to this the Allis-Chalmers Company has secured from the American Steel & Wire Company orders for two large gas engines for its central furnaces at Cleveland, Ohio, of the same rating as the engines for the Gary plant.

Stone & Webster Companies.—The June number of the Stone & Webster Service Journal declares that during the month of April all of the companies operated by that firm showed creditable advances in earnings. The properties are scattered all over the country, and from every section the report is that business is increasing and the population growing. A special improvement is noted in the far Northwest, where the Bellingham Bay & British Columbia Railway makes a report that its gross earnings increased 25 per cent over April, 1909. The increase in earnings of the Texas properties is also very large. The other Southern properties also show large gains. Taken as a whole, the outlook for the coming year for the various Stone & Webster companies is exceptionally favorable.

Steinway Tunnel Operation.—An official of the Interborough Rapid Transit Company has made the statement that now that Governor Hughes has signed the Steinway tunnel bill the company expects to have the tunnel in operation by the end of the year. This program, of course, assumes that proper franchises can be speedily obtained from the city authorities. The Interborough intends to carry passengers for one 5-cent fare from the east terminus of the tunnel to any portion of the subway system. It is generally thought that the Interborough's action in this tunnel matter will bring about favorable consideration of its proposed extension plans now before the Public Service Commission.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Streator, Ill.; Las Vegas, N. M.; Corpus Christi, Tex.; Austin, Tex.; Grants Pass, Ore.; Bakersfield, Cal.; Fort Slocum, N. Y. Batavia, Ill.; Milwaukee, Wis.; St. Paul, Minn.; Richmond, Ind.; Racine, Wis.; Indianapolis, Ind.; Evansville, Ind.; Logan, Utah; Moberly, Mo.; Washington, D. C.; Gary, Ind.; Rock Hill, S. C.; Oxford, Miss.; Bessemer, Ala.; Baltimore, Md.; Redmond, Ore.; Longueuil, Que., Can., and Collinsville, Ill.

United Wireless in Canada.—Application has been made to the Canadian marine department by the United Wireless Telegraph Company for license to erect and operate wireless stations in Canadian territory bordering the Great Lakes. The stations are to be located at Port Arthur, Collinwood, Sarnia and St. Thomas. The United company has 26 wireless stations on the United States shores of the Great Lakes, and has equipped 72 vessels. In order to secure its Canadian franchises the company agrees to exchange messages with any other systems or companies.

Potomac Electric Power Company.—The Potomac Electric Power Company, of Washington, has begun the installation of the 9000-kw steam turbine in its station at Benning3. The new machine will replace two 2000-kw turbines now in use. This station furnishes energy for lighting the city of Washington and vicinity. The cost of the new installation will be about $150,000.

New York Metal Exchange.—At the meeting of the individual members of the New York Metal Exchange last week, the action of the Board of Managers in disposing of the property on Pearl Street was strongly endorsed. It is proposed to lease new quarters in the Trinity Building, 111 Broadway, and to enlarge the scope of the exchange.

Financial.

THE WEEK IN WALL STREET.

SENTIMENT in Wall Street was slightly better last week and prices not only held firm, but in many instances recorded small advances, but the volume of trading was not improved. The financial center has rarely seen a duller week than that just passed. Outside buying was entirely absent, and even local traders were slow to take hold of any large lots. The bears were a trifle less aggressive than they were earlier in the month, while the bulls were as persistent as formerly in upholding prices. This explains how the market advanced on such scanty trading. The passage of the railroad bill was rather a relief than otherwise. This at least removes the element of uncertainty as to what Congress would do in this direction. All kinds of opinions as to the effect of this legislation can be heard in Wall Street, but the more conservative view is that it will have to be tested in the courts before it can accomplish any serious harm. There is a general belief that the Interstate Commerce Commission will display absolute fairness as between the railroads and the shippers. One thing that improved the sentiment in the financial world last week was the publication of the May figures of foreign trade, which showed a very greatly improved condition over earlier months in the spring. The money market has shown little tendency to stiffen, and rates are still easy. There is more money in the banks than is being demanded for legitimate business purposes. Rates June 20 were: Call, 2¼@3 per cent 90 days, 3¾ per cent. The quotations in the table are those of the close June 20.

NEW YORK.

	June 13.	June 20.	Shares sold.		June 13.	June 20.	Shares sold.
All.-Ch.	9*	9	600	Int.-Met., pfd.	51	52	5,500
All.-Ch., pfd.	30*	30⅛*	340	Mackay Cos..	88	88*	600
Amal. Cop...	63¼	65¼	182,050	Mackay C., p.	76*	74⅜*	200
Am. D. T....	20½*	20½*	———	Man. Elev...	130*	130*	310
Am. Loc.....	43	44½	2,000	Met. St. Ry..	15*	15*	———
Am. Loc., pfd.	105¼	107¾	200	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	75*	75*	———	Steel, com...	77¾	78⅛	347,640
Am. T. & T..	134⅞	137	5,700	Steel, pfd....	115½	116⅛	6,196
B. R. T.....	77¾	79⅛	20,060	W. U. T....	63	64½*	900
Gen. Elec....	144½	147	1,200	West'h., com.	59¾	63¼	850
Int.-Met.	18⅞	19	3,390	West'h., pfd..	111*	114	———

PHILADELPHIA.

	June 13.	June 20.		June 13.	June 20.
Am. Rys.....	44*	44*	Phila. Elec.....	15	14⅞
Elec. Co. of A....	11½	11½*	Phila. R. T.....	19	20⅝
Elec. St. B'ty.....	54¾	54¼	Phila. Trac.....	84*	84½*
E. S. B'ty, pfd....	30*	30*	Union Trac.....	46¼*	47

CHICAGO.

	June 13.	June 20.		June 13.	June 20.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	119	120
Chi. Rs., Ser. 1....	75*	75*	Met. El., com.....	21½*	24½
Chi. Rs., Ser. 2....	18½	17	Met. El., pfd.....	63*	69
Com. Edison.....	114½	116*	Nat'l Carbon.....	114¼	117
Chi. Subways.....	2½*	2½*	Nat'l Car., pfd.....	119*	119*

BOSTON.

	June 13.	June 20.		June 13.	June 20.
Am. T. & T.....	134⅞	136¾	Mex. Tel.....	6*	5⅝*
Cum. Tel.....	145*	142	Mex. Tel. pfd.....	6¼	6¼*
Edison E., Ill.....	248	248	N. E. Tel.....	134½	132½
Gen. Elec.....	143¾*	147¼	W. T. & T.....	15¾*	15¾*
Mass. E. Ry.....	16½	16	W. T. & T., pfd....	86*	86*
Mass. E. Ry., pfd...	80	80*			

* Last price quoted.
Shares sold for week of June 13 to June 18.

FINANCIAL NOTES.

Finances of Commonwealth Edison Company.—Directors of the Commonwealth Edison Company have decided to retire the $5,335,000 Chicago Edison Company 5 per cent bonds now outstanding. The company will not only issue sufficient new bonds to take care of the Chicago Edison issue, but will provide also for the company's present requirements. The bonds are to be put out under the company's first mortgage. Edison bondholders are to be given an opportunity to exchange their old bonds for new bonds. After the Chicago Edison bonds have been retired the Commonwealth Edison Company will have but one class of mortgage debt, being the first mortgage 5 per cent bonds due 1943. Owing to the fact that the company's bonds are held by investors in New York and London as well as in Chicago the company has arranged with an underwriting syndicate to take all the bonds not subscribed for under the arrangement to be made. This syndicate, it appears, has been decided upon as the one which will for a number of years handle Commonwealth Edison securities when placed before the public. It consists of the Illinois Trust & Savings bank, Harris Trust & Savings Bank, Northern Trust Company, Continental and Commercial National Bank, First Trust & Savings Bank, Merchants Loan & Trust Company, Russell, Brewster & Company and N. W. Halsey & Company.

Edison General Electric Company to Dissolve.—The stockholders of the Edison General Electric Company have been called to meet July 15 at Schenectady for the purpose of voting on the question of the dissolution of the company. The company exists in name only, its existence having been continued after the General Electric Company was formed merely to protect certain patent rights. These have now expired and there is no longer occasion for the original company's existence. Hinsdill Parsons, vice-president of the General Electric Company, said: "The Edison General Electric is a company which owned a factory in Schenectady. The title was transferred to the General Electric Company and the proposed dissolution is simply an internal affair, merely a simplification of doing business. It is something that has been contemplated for a long time, and has absolutely nothing to do with the Federal anti-trust activity."

United Light & Railways Company.—A corporation has been organized by Child, Hulswit & Company, of Grand Rapids, Mich., under the laws of Maine, called the United Light & Railways Company, which is to take over the gas, electric and traction properties owned by this firm. The company will have an authorized capitalization of $12,500,000 first preferred 6 per cent cumulative stock, $5,000,000 second preferred 3 per cent cumulative stock, and $12,500,000 common stock. The properties taken over are: Fort Dodge (Ia.) Light Company; Muscatine (Ia.) Light & Traction Company; Cadillac (Mich.) Gas Light Company; La Porte (Ind.) Gas Light Company; Matoon (Ill.) Gas Light Company; Chattanooga (Tenn.) Gas Company; Cedar Rapids (Ia.) Gas Light Company, and La Porte (Ind.) Electric Company.

Massachusetts Lighting Companies.—At the meeting of the trustees of the Massachusetts Lighting Companies last week the regular quarterly dividend of 1¾ per cent was declared. During the past year the Massachusetts Lighting Companies has reduced the price of gas and electricity in 17 out of the total of 31 towns and cities which it serves. This reduction has had its usual effect in causing a more general use of gas and electricity by the public and manufacturers. The towns and cities served by the Massachusetts Lighting Companies now have a total population of about 180,000. Since the above reductions in prices have been made gross sales have increased by about 15 per cent in the first five months of 1910, or $46,864, over the same period in 1909.

Philadelphia Rapid Transit Financing.—The Council of Philadelphia has passed the ordinance authorizing the new Philadelphia Rapid Transit financing plan. This plan involves the sale outright of the securities in the insurance fund, and the sale of the Union Traction Company of all the Philadelphia Rapid Transit rolling stock. The latter will then be leased to the Rapid Transit company for 10 years, the lease to be made the basis of an issue of $1,500,000 5 per cent car trust certificates, which will be guaranteed by the Union Traction Company. This supersedes the original plan for issuing $2,500,000 of bonds. The condition of the bond market made the former plan impracticable.

C. H. Geist Combines Indiana Properties.—On June 15 gas and electric light plants in 10 cities and towns in northern Indiana passed to the control of Charles H. Geist of Philadelphia. The merger involves $2,000,000 and includes the combining of the South Bend & Mishawaka Gas Company, of South Bend; the Plymouth Lighting Company, of Plymouth, with the Northern Indiana Gas & Electric Company, which controls and operates gas and electric light plants at Hammond, Whiting, East Chicago, Indiana Harbor, Chesterton, Porter and Michigan City. The headquarters of the combine will be in South Bend.

Associated Gas & Electric Company.—The net earnings of the Associated Gas & Electric Company, the new concern organized last year by W. S. Barstow & Company, are said to be for the first year of its history more than double the amount required to pay the dividends on the outstanding preferred stock. A quarterly dividend of 15 per cent has been declared, payable June 30. The company operates gas and electric properties in New York, Pennsylvania and Ohio.

Henry L. Doherty's Deal in Montgomery, Ala.—For some weeks it has been known that H. L. Doherty & Company, who control the Montgomery (Ala.) Light & Water Power Company, have been negotiating for the purchase of a competitive company, the Citizens Light, Heat & Power Company. Details of the transaction have been withheld, but now the entire deal has been brought to light in the courts of Alabama. Last week Doherty & Company brought an injunction suit in Montgomery to prevent Alex Rice, president of the Citizens Light, Heat & Power Company, from disposing of the stock of that company, claiming that he had already signed a contract to sell 80 per cent of the stock to Doherty & Company. The delivery of this stock was to have been made June 15 in Montgomery, but when Mr. Doherty and Frank W. Frueauff went to that city to pay the purchase money and receive the shares, they could not obtain a transfer. With the bill filed by Mr. Doherty upon which the temporary injunction was obtained are copies of two contracts entered into between Rice and Henry L. Doherty & Company. These are dated May 13, and the first calls for the payment of $35,000 to Rice, P. R. Whiting, general manager of the company, and F. S. Ball, attorney, to compensate them for their services and to secure their good will in the transfer. This money was to be paid in 24 equal monthly installments, beginning July 1, 1910. In the second contract Rice agrees to deliver to Doherty 800 of the 1000 outstanding shares of the Citizens stock at $75 per share, and guarantees that this will cover the outstanding debts of the company; otherwise any excess shall be subtracted from the payment of $35,000; it was this stock that was to be delivered June 15, and it was the failure of this delivery that caused Doherty & Company to ask for an injunction. Doherty & Company under the purchase contract agreed to assume the bonded debt of $50,000 of the Citizens company. For the past two years there has been very active competition in Montgomery between the two lighting companies.

Earnings of Chicago City Railway.—For three months ended April 30, 1910, the Chicago City Railway Company (including the Southern Street Railway Company) reports gross earnings of $2,311,854; total expenses, $1,603,218; net earnings from operation, $708,636. In each case these figures are a little over 6 per cent greater than the corresponding amounts in 1909. On April 15 the rehabilitation of the company's property was completed as required by ordinance, 70 per cent of the gross earnings having been expended upon maintenance and renewals for the entire period of "immediate rehabilitation." Commencing April 16, 8 per cent of the gross earnings has been set apart as a fund for renewals and depreciation, as required by the ordinance. The city receives 55 per cent of the net earnings, as computed.

Dividends.

American Cities Railway & Light Company, quarterly, preferred 1½ per cent, common 1¾ per cent, both payable July 1.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable July 1.

Associated Gas & Electric Company, preferred, quarterly, 1½ per cent, payable June 30.

Baltimore Electric Company, semi-annual, preferred, 2½ per cent, payable July 1.

Bangor (Me.) Railway & Electric Company, quarterly, payable July 1.

Canadian General Electric Company, quarterly, 1¾ per cent, payable July 1.

Cincinnati, Hamilton & Dayton Traction Company, quarterly, preferred, 1¼ per cent, common ⅝ per cent, both payable July 1.

Cincinnati Suburban Bell Telephone Company, quarterly, 2 per cent, payable July 1.

Columbus (Ga.) Electric Company, semi-annual, preferred, 3 per cent, payable July 1.

Detroit Edison Company, quarterly, 1½ per cent, payable July 15.

Duluth-Edison Electric Company, preferred, quarterly, 1½ per cent, payable July 1.

Electric Storage Battery Company, quarterly, preferred and common, 1 per cent, payable July 1.

El Paso (Tex.) Electric Company, semi-annual, preferred, 3 per cent payable July 11.

Hestonville, Mantua & Fairmount Passenger Railway Company (Philadelphia), semi-annual preferred, 3 per cent; common 2 per cent, both payable July 1.

Manila Electric Railroad & Light Corporation, quarterly, 1 per cent, payable July 1.

Narragansett Electric Lighting Company, Providence, quarterly, 1 per cent, payable July 1.

Nebraska Telephone Company, quarterly, 1½ per cent, payable July 10.

New England Telephone & Telegraph Company, 1½ per cent, payable June 30.

Union Passenger Railway Company (Philadelphia), 9½ per cent, payable July 1.

Union Switch & Signal Company, quarterly, preferred and common, 3 per cent, each payable July 9.

Washington Water Power Company, quarterly, 1¾ per cent, payable July 1.

Welsbach Company, annual, 2 per cent, payable June 30.

Westinghouse Air Brake Company, quarterly, 2½ per cent, extra, 1½ per cent, special, 2 per cent, payable July 1.

West Philadelphia Passenger Railway Company, semi-annual, 10 per cent, payable July 1.

Reports of Earnings.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Blackstone Valley, Gas & Electric Company:					
April, 1910	$78,016	$36,317	$41,699	$29,317	$12,382
April, 1909	72,713	38.932	33.781	29.414	4,367
British Columbia Electric Railway Company, Vancouver:					
April, 1910	247,307	153,776	93,531	.....	.....
April, 1909	188,071	109,267	78,804	.....	.....
Dallas Electric Corporation:					
April, 1910	113,405	74,510	38,895	26.599	12,296
April, 1909	100,963	61,678	39,285	28,832	10,453
Edison Electric Illuminating Company of Brockton:					
April, 1910	22,829	12,978	9,851	3,795	6,056
April, 1909	20,722	11,872	8,850	3.186	5,644
El Paso Electric Company:					
April, 1910	49,490	28,874	20,616	8,307	12,309
April, 1909	46,493	29,305	17,188	7.900	9,288
Fairmont & Clarksburg Traction Company:					
May, 1910	51,827	18,552	33,275	12.609	20,666
May, 1909	42,122	13,362	28,760	12,309	16,451
Galveston-Houston Electric Company;					
April, 1910	104,549	66,159	38,490	23,540	14,950
April, 1909	93,720	55,245	38,475	21.260	17,215
Keystone Telephone Company:					
May, 1910	96,688	45,791	50,897	.....	.....
May, 1909	91,727	45,055	46,672	.....	.....
Lowell (Mass.) Electric Light Corporation:					
April, 1910	35,489	18,407	17,082	4,686	12,396
April, 1909	27,981	17,396	10,585	4,184	6,401
Minneapolis General Electric Company:					
April, 1910	101,141	43,254	57,887	30,634	27,252
April, 1909	84,450	39,901	44,548	30,098	14,450
Northern Texas Electric Company:					
April, 1910	111 270	61,001	50,278	19,081	31.197
April, 1909	97,836	56,532	41,304	17,189	24,115
Pensacola Electric Company:					
April, 1910	22,262	12,754	9,508	4.937	4,571
April, 1909	18,558	11,468	7,090	4.321	2,769
Puget Sound Electric Railway Company:					
April, 1910	158,918	105,572	53,346	50,547	2,799
April, 1909	143,580	103,886	39,694	33.387	*6,307
Seattle Electric Company:					
April, 1910	460,490	273,266	187 224	108,708	78,516
April, 1909	422,123	261,843	160,285	104,140	56,145
Terre Haute, Indianapolis & Eastern Traction Company:					
Year Ended March 31, 1910	5,451,176	3,019,553	2,431,623	.....	.....
Year Ended March 31, 1909	5,078,685	2,803.679	2,275,006	.....	.....

* Deficit..

General News

Construction News.

BESSEMER, ALA.—The Birmingham Water & Electric Power Company, of Birmingham, Ala., is reported to be contemplating the construction of a dam across the Warrior River, and proposes to furnish electricity and water in Bessemer. The company has applied to the City Council for a franchise in Bessemer to furnish both water and electricity.

GENEVA, ALA.—The Geneva & Enterprise Traction Company is reported to be contemplating the erection of a power plant on Double Creek.

MOBILE, ALA.—The contract for installing the electric lighting system in the buildings at Fort Morgan, Ala., also erecting pole lines, street lamps, fixtures, etc., has been awarded to the Mobile Electrical Supply Company, of Mobile, Ala., for $18,217.

TALLADEGA, ALA.—The Alabama Power & Development Company is reported to be negotiating for the construction of an electric railway from Talladega to Gadsden by the way of Anniston, for which surveys will soon be made.

LITTLE ROCK, ARK.—The State Board of Railroad Incorporation has granted the Little Missouri Power Company a franchise to establish a power plant on the Little Missouri River, near Murfreesboro, in Pike County. The officers of the company are: M. W. Greeson, president; W. N. Bemis, vice-president; L. W. Beidleman, secretary, and H. E. Bemis, treasurer.

STONEWALL, ARK.—The Lawton Basket & Box Company, it is reported, would like to receive estimates on a small electric generator.

BAKERSFIELD, CAL.—The Kern River Oilfields of California, Ltd., which on April 1 took over the Imperial and 33 oil properties in the Kern River oil fields, and a large acreage of undeveloped land from Keith & Mack, is preparing plans for the installation of an electric plant and for drilling of sufficient number of wells to increase the production to 350,000 barrels yearly. The cost of the electric plant is estimated at $250,000.

BARBER (P. O. CHICO), CAL.—The Diamond Match Company is reported to have entered into a contract with the Pacific Gas & Electric Company to supply electricity to operate all of the departments of its manufacturing plant at Barber. The contract calls for 1200 hp, but only about 750 hp will be used at first. A new transmission line will be erected from the Chico substation. A substation will be erected at the factory of the Diamond Match Company. G. C. Holburton, of San Francisco, Cal., is chief engineer of the Pacific company.

BODIE, CAL.—Preparations are being made by the Hydro-Electric Company, of Bodie, to erect a transmission line to Rawhide, Nev., to supply this camp with electricity for lamps and motors.

GLENDALE, CAL.—The installation of an electric lighting system in Glendale is reported to be under consideration.

LIVERMORE, CAL.—The Board of Supervisors has granted the Sierra & San Francisco Power Company a franchise to erect a telephone line between Livermore and Niles. The proposed line will be used entirely by the company and will pass through the Ranohe El Valle de San Jose and over the Mission San Jose road to Niles.

LOS ANGELES, CAL.—Plans are being considered for the installation of an electric light system on Sunset Boulevard to Bungalow Land in Laurel Canyon by the owners of Lookout Mountain Land and C. F. Harper.

LOS ANGELES, CAL.—At a special meeting of the officials of the Pacific Light & Power Company it was decided to drop all improvements and extensions within the city and return to the treasury of the corporation the greater portion of the $3,000,000 fund set aside for the yearly work of improvements and extensions in the city and country. This action was taken as the result of the adoption of an ordinance by the City Council lowering the rates for electricity for lamps from nine to seven cents per kw-hour.

LOS ANGELES, CAL.—Owing to the action of the City Council in reducing the telephone and electric light rates in Los Angeles, the Southern California Edison Company is reported to have posted orders for the signing of no more lighting contracts, following in the footsteps of the Los Angeles Gas & Electric Corporation and the Pacific Light & Power Corporation. The Edison Company has turned back into its treasury $250,000 remaining from the $400,000 authorized to be spent this year. The Los Angeles Gas & Electric Corporation's original budget called for the expenditure of $1,800,000 for extensions in the city this year, of which about $900,000 was to have been expended for improvements to its electric system. About $500,000 of this remains in the treasury.

OAKLAND, CAL.—In the report submitted by K. B. Miller, consulting engineer, employed by the City of Oakland to investigate the gas and electric lighting system in this city, recommends that the present 220-440-volt alternating-current electric system now furnished by the Oakland Gas, Light & Heat Company should be discontinued, and the standard 110-220-volt system, with grounded neutral, be adopted in its stead. He recommends that the street lighting system to remain as at present for another year, at least, owing to the rapid progress now being made in the development of arc lamps and large unit incandescent lamps, and that the matter be investigated and reconsidered at the end of another year. In connection with the electrolier system of lighting he suggests that the present carbon lamps be replaced by multiple tungsten lamps having an efficiency of 1.25 watts per cp. He also recommends that the city no longer consider the use of Welsbach gas mantels for illuminating the streets.

OROVILLE, CAL.—Work has commenced on the construction of a large dam across the Feather River, above the head of the tunnel in the Big Bend, 30 miles from Oroville, by the Great Western Power Company.

OROVILLE, CAL.—The superior court has granted the Pacific Gas & Electric Company a temporary injunction against the Oro Light & Power Company, a branch of the Steifer Mining Company, operating near Magalia, preventing it from using the waters of the west branch of Feather River for power purposes. The Steifer Company is building a dam in the west branch about a mile above that of the Oro Light & Power Company, which the Pacific Company claims will interfere with its water rights used for power development and irrigation purposes.

PASADENA, CAL.—The struggle between the City of Pasadena and the Southern California Edison Company has been renewed. The city, on June 13, reduced the rate for electricity furnished by the municipal electric plant to 5 cents per kw-hour. Until within a few months the city has paid 12½ cents per kw-hour, when the Edison Company cut the price to 5 cents, with the purpose, it is said, of putting the municipal plant out of business. The city has now met the cut, and the officials of the plant say that the service can be furnished at that rate and still make money, provided the number of patrons is increased from 2125 to 4000. A vigorous campaign has been commenced by the advocates of municipal ownership to secure the number desired. Since the announcement of the reduction in price to 5 cents by the city the Southern California Edison Company has announced that its price will be reduced to 4 cents per kw-hour.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company has awarded a contract to R. D. Wood & Company for a 5,000,000-cu. ft. gas holder, to be erected in the Petrero, adjoining the present gas plant there.

SAN FRANCISCO, CAL.—According to advices received from Washington, D. C., the rights of the City of San Francisco at Lake Eleanor and Hetch-Hetchy Valley are threatened from another source than the possible revocation of the Hetch-Hetchy permit. The National Park Electric Power Company has applied for a right of way and certain power sites, reservoir sites and canal rights of way in the Stanislaus national forest, on the south fork of the Tuolumne River. If the application is granted the rights of San Francisco under the Lake Eleanor-Hetch-Hetchy permit will be impaired, if not destroyed. The National Park Electric Power Company was incorporated in San José in 1903, with the following-named directors: A. G. Kuhn, president; C. J. Kuhn, secretary and manager; R. W. Hersey, P. J. Dunne and C. W. Quilty, all of San José, Cal. G. S. Wakefield is chief engineer.

SAN FRANCISCO, CAL.—The only bid received by the Board of Supervisors for lighting the public buildings and streets was submitted by the San Francisco Gas & Electric Company, which was referred to the committee on artificial lights of the Board of Supervisors. The company offers to furnish gas to public buildings, offices, yards and public places at the rate of 60 cents per 1000 cu. ft.; electricity for lamps at the rate of 3 cents per kw-hour; for motors, 3 cents per kw-hour; for each arc lamp inside public buildings, or grounds adjacent thereto, when not connected with a metered service, 2½ cents per lamp-hour; for each electric arc lamp, with all-night service, 19.727 cents each per night. The present rate is 20.712 cents. For each electric arc lamp with midnight service, 13½ cents per lamp per night; 13.80 cents is the present rate; for each electrolier of the type now in use in the downtown retail shopping district, with all-night service, 19.727 cents each per night. It is understood that this bid is $17,000 less than the present rates.

SAN LEANDRO, CAL.—The Board of Trustees has granted the People's Electric Light & Power Company a franchise to construct and operate an electric light system in this city.

SUISUN, CAL.—It is reported that the Pacific Gas & Electric Company, of San Francisco, has purchased the electric light, heat and power systems in Suisun and Fairfield, owned by Leonard Prior, of Suisun, Cal.

DANBURY, CONN.—Preparations are being made by the Danbury & Bethel Gas & Electric Light Company to install a new 1000-kw steam turbine in its power station on Pahquloque Avenue. Also two 300-hp Heine boilers, condensing apparatus, pumps, switching apparatus, etc., contracts for which have already been placed.

TORRINGTON, CONN.—It is reported that plans are being considered for an extension of the Torrington & Winchester Street Railway, from Torrington to Litchfield and to Bamtam Lake. The proposed extension would be nine miles in length, for which a charter has already been secured.

WASHINGTON, D. C.—Work has commenced on the foundations for the new 9000-kw steam turbine to be installed in the Bennings station of the Potomac Electric Power Company. The new machine will replace two 2000-kw steam turbines now in use in the plant. This power station furnishes electricity for lighting the City of Washington and vicinity and a large portion for the electric railways. The cost of the installation is estimated at $150,000. C. S. Wilson, chief engineer, will have charge of the work.

ATLANTA, GA.—The Paulding Power Company has applied to the State Railroad Commission for permission to issue $40,000 in capital stock and $40,000 in bonds.

ATLANTA, GA.—The Georgia Power Company, which recently purchased the property of the Etowah Power Company at a receivers' sale, has applied to the City Council for a franchise. The company has also applied to the State Railroad Commission to issue $6,000,000 in bonds and $6,000,000 in capital stock.

ATLANTA, GA.—It is reported that Harry Leslie Walker has been engaged to prepare plans and to take charge of the construction of the addition to the Grady Hospital. It is said that considerable electrical apparatus will be used in the new addition, and also in the old building. For further information address Mr. Walker, at 90 North Pryor Street, Atlanta, Ga.

ATLANTA, GA.—Arrangements are being made by the Atlanta Hydro-Electric Power Company for further financing its project. The company proposes to construct a dam 700 ft. in length across the Tugaloo River, where it is estimated that 25,000 hp can be developed. This will be transmitted to Atlanta and other towns between this city and the power plant.

DONALDSONVILLE, GA.—The new electric light plant now being constructed will be completed in a few weeks. The J. B. McCrary Company, of Atlanta, Ga., are the engineers.

THOMASVILLE, GA.—Plans are being considered for the installation of an engine in municipal electric light plant, at a cost of about $3,000.

COLLINSVILLE, ILL.—The City Council is reported to have granted Jacob Frey, E. B. Hess and others of Hillsboro, Ill., a 3-year franchise to operate an electric light plant in Collinsville, and also a ten-year contract to furnish electricity for lighting the city. The above-named parties, it is said, will take over the property of the Collinsville Electric Light, Heat & Power Company for a consideration of $25,000. Under the provisions of the franchise the new company must erect a new plant and have it in operation within six months. It is understood that the improvements to be made will cost about $150,000. The company will extend its transmission lines to Marysville, Caseyville and probably other nearby towns.

BATAVIA, ILL.—Plans are being made by the Aurora, Elgin & Chicago Railroad Company for the installation of two additional Edge Moor water tube boilers in its Batavia plant this summer.

STREATOR, ILL.—The Economy Light & Power Company, which recently purchased the property of the Illinois Light & Traction Company in this city, will erect an entire plant and system in Streator at a cost of $250,000.

CRAWFORDSVILLE, IND.—The Trustees of the Crawfordsville electric light and power plant are asking for bids for furnishing steam turbines, electric generators, boilers, mechanical stokers, motors, transformers, arc lamps and other equipment for the new municipal electric light and power plant. The Esterline Company, of Lafayette, Ind., have charge of construction of the plant.

EVANSVILLE, IND.—Contracts have been awarded by the Evansville Electric Railway Company for the erection of two power stations to the General Electric Company, of Cincinnati, Ohio; one to be located at Rockport and the other at Newburg.

EVANSVILLE, IND.—The capital stock of the Evansville Public Service Company has been increased from $250,000 to $1,000,000. The company proposes to establish an electric light, power, steam and hot water heating plant in Evansville, for which a site has already been purchased.

GARY, IND.—It is reported that plans are being considered by the United States Steel Corporation for the construction of a duplicate of its electric power plant in Gary, which cost $4,500,000. The company is also contemplating extensions and improvements to the present plant, to cost $1,000,000. The plant furnishes electricity for operating the steel works, blast furnaces and also for lamps and motors in Gary and surrounding towns.

HAMMOND, IND.—The Northern Indiana Gas & Electric Company is reported to have been consolidated with the South Bend & Mishawka Gas Company, of South Bend, Ind., and the Plymouth Lighting Company, of Plymouth, Ind. C. H. Geist, of Philadelphia, Pa., president of the three companies, will be president of the new company.

INDIANAPOLIS, IND.—Plans are being prepared by the Merchants' Heat & Light Company to install a 3000-kw, alternating-current generator and a Corliss cross-compound engine.

JONESBORO, IND.—Negotiations have been closed whereby the town of Jonesboro has disposed of its interest in the Jonesboro Light & Water Company to the Trobridge & Niverton Bonding Company, of Chicago, Ill. The new owners, it is said, will make extensive improvements to the plant at once and establish a 24-hour service.

LA PORTE, IND.—Messrs. Harning & Andrew have sold their interest in the La Porte Electric Company to the Childs-Hulswit Company, of Grand Rapids, Mich., which owns and operates the La Porte Gas Light Company. The consideration was $250,000.

RICHMOND, IND.—It is reported that plans are being prepared for the installation of an engine-driven, direct-current generator with a rating of from 100 to 125 kw in the implement and wagon factory of the Wayne Works, Richmond, Ind. The plant will furnish electricity for lamps and motors for the plant.

ST. JOHN, IND.—The Northwestern Telephone Company, of St. John, Ind., is reported to have increased its capital stock from $10,000 to $25,000, the proceeds to be used for improvements and extensions to its system.

SOUTH BEND, IND.—On June 15 gas and electric plants in 10 cities and towns in northern Indiana passed to the control of Charles H. Geist, of Philadelphia, Pa. The merger includes the properties of the South Bend & Mishawaka Gas Company, of South Bend, Ind.; the Plymouth Lighting Company, of Plymouth, Ind., with the Northern Indiana Gas & Electric Company, which controls and operates the gas and electric plants at Hammond, Whiting, East Chicago, Indiana Harbor, Chesterton, Porter and Michigan City, Ind. The headquarters of the company will be located in South Bend, Ind.

IOWA CITY, IA.—We are informed that the Iowa City Electric Railway Company will commence work on construction of its proposed railway in July, contracts for which will be awarded soon. Electricity for operating the system will be purchased. The company is capitalized at $100,000. J. O. Schulze is president and general manager.

LAKE CITY, IA.—The Central Mutual Telephone Company is making extensive improvements to its local service, which will involve an expenditure of $20,000, and include the placing of its wires underground in the business district of the city.

NASHUA, IA.—It is reported that W. J. Bowen & Sons, of Nashua, Ia., will soon award contracts for the construction of a concrete dam and flumes, in connection with the building of a hydroelectric power plant.

PAULLINA, IA.—We are informed that the contract for the construction of a municipal electric light and power plant in Paullina has been awarded to the International Supply Company, of Sioux City, Ia., for $11,500. David Algyer is town clerk.

CANTON, KAN.—At an election held June 7 the citizens voted in favor of the proposition to issue $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system.

JEWELL, KAN.—The Jewell County Telephone Company, it is said, is making preparations to rebuild its telephone lines from Formoso to Superior, and extensions to Kebber and Lovewell.

BALTIMORE, MD.—It is reported that plans are being prepared by Parker, Thomas & Rice, Union Trust Building, Baltimore, Md., for the construction of a power house and ice plant at Bayview, to cost about $25,000. Henry Adams, Calvert Building, Baltimore, is supervising engineer.

ELKTON, MD.—At an election to be held July 11 the proposition to issue $60,000 electric light, sewer and water bonds will be submitted to a vote. H. Arthur Mitchell is president of the commissioners.

FROSTBURG, MD.—The City Council has awarded the contract for lighting the streets of the city to the Frostburg Illuminating & Manufacturing Company, of Frostburg, Md. Under the terms of the contract the company is to furnish arc lamps at the rate of $68 each per year, and 32-cp incandescent lamps at $15.84 per lamp per year.

OAKLAND, MD.—Preparations are being made by the Oakland Electric Light Company for the installation of a 125-hp gas engine, contract for which has been awarded. Natural gas will be used for fuel.

FRANKLIN, MASS.—The Union Electric Light Company has submitted a proposition to the selectmen offering to replace the present street lighting system, which consists of both arc and incandescent lamps, for an all-incandescent lamp system. The company offers to install a cluster of five 40-cp lamps in place of each of the arc lamps now in use, and to use nothing but 40-cp lamps throughout the town, and also offers to supply the town with 16 additional lamps, to be distributed in any part of the town.

HOLYOKE, MASS.—W. H. Snow, manager of the municipal electric light plant, has awarded the contract for putting in the foundations for additions to the lighting plant to Daniel O'Connell's Sons, for $3,280. Orders have been placed for equipment to be placed on the foundations.

HOPEDALE, MASS.—The Draper Company, of Hopedale, Mass., manufacturers of looms and textile machinery, is enlarging its plant and equipping a large portion of the machinery for electric motor drive. The company has awarded the Allis-Chalmers Company, of Milwaukee, Wis., the contract for electrical apparatus, including a 1250-kva, 600-volt, 60-cycle, three-phase, 3600-r.p.m., steam turbo-alterator; a 15-kw. turbine-driven exciter and a 15-kw, motor-driven exciter; a three-panel switchboard; one 300-hp and one 400-hp, wound rotor, induction motors.

WESTFIELD, MASS.—Bids will be received until June 29 by the commission repaving Elm Street and Park Square at the office of the town clerk for constructing underground electric conduits, including 9000 ft. of conduit, varying in size from 1 to 12 ducts, together with necessary manholes and other appurtenances. Lewis C. Parks is secretary of commission; Oren E. Parks is town engineer. Plans and specifications can be secured at the office of the town engineer.

WORCESTER, MASS.—The Royal Worcester Corset Company, of Worcester, Mass., has been granted a permit to enlarge its power house in the rear of Wigwam Street, to cost $10,000. The Norcross Brothers' Company has the contract for construction of the building.

BAY CITY, MICH.—The City Council has decided to accept the proposition of the Titabawassee Power Company to furnish electricity to operate the municipal electric system at eight miles per kw-hour. The contract will go into effect July 1, 1911, and will mean the abandonment of the present municipal plant and the erection of a new station to distribute energy received from the Titabawassee Power Company.

BLISSFIELD, MICH.—The Continental Sugar Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 36, "Reliance" type, heavy duty, Corliss, belted engine for its new beet sugar factory now under construction in Blissfield, Mich.

KALAMAZOO, MICH.—The Upjohn Company, it is reported, is preparing to install an electric power plant to furnish electricity to operate its works. The equipment will include four boilers, generators and motors. The cost of the plant is estimated at $20,000.

OWOSSO, MICH.—Plans have been prepared by the Reliance Motor Company for the erection of a new factory in Owosso, Mich. The main building will be 384 ft. x 579 ft., two stories high. A 2000-hp power plant will be installed in connection with the new factory.

MINNESOTA TRANSFER, MINN.—Arrangements are being made by the Park Wagon-Stock Company to light its plant by electricity and equip part of its machinery for electric motor drive. Orders have recently been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for a 16 x 36, "Reliance" type, heavy duty, belted Corliss engine; a 75-kw, 120-volt direct-current generator; two 25-hp, one 15-hp and one 10-hp, direct-current motors; also a two-panel switchboard for controlling various circuits.

REDWOOD FALLS, MINN.—The Wherwood Electric Company is reported to have commenced work on the erection of transmission lines to extend its service to North Redwood.

ST. PAUL, MINN.—Preparations are being made by McGill, Warner & Company, of St. Paul, Minn., for the installation of electrical machinery, including a 75-kw, direct-current, engine-driven generator.

ST. PAUL, MINN.—A site has been chosen by the St. Paul Business League for the new power building to be erected in St. Paul. It is proposed to erect a large building to rent to small industrial manufacturers, with power service at a reasonable rate. The building will be seven stories high, with a floor surface of about 189,600 square feet, and will cost from $220,000 to $300,000. Webster Wheelock is chairman of the committee.

AMORY, MISS.—Arrangements have been completed for the purchase of the electric plant of the Amory Light & Power Company, which will be operated by the municipality. Bonds to the amount of $18,000 were recently voted to pay for the plant. J. P. Johnston is Mayor.

COLLINS, MISS.—Contracts will soon be awarded by the City Council for the installation of an additional equipment for the municipal electric plant, bids for which have been received. Preparations are being made to establish a day service.

OXFORD, MISS.—It is reported that extensions will be made to the municipal electric light plant and water works system, for which bonds to the amount of $30,000 have been voted. The proposed improvements will include one mile of transmission line, motor pumps and cable sufficient to pull motor pumps and construction of a 200,000-gal. masonry reservoir and one-quarter mile of 8-in. water main. W. L. Smith is city clerk.

HARDIN, MO.—The local electric light plant, owned by J. W. McMichael, was recently destroyed by fire. It is understood that the plant will not be rebuilt.

MOBERLY, MO.—The City of Moberly is considering the purchase of three tubular boilers, a steam pump with a rating of 200,000 gal. daily, tandem Corliss four-valve engine with two 100-kw generators, with auxiliary equipment; also motor-driven deep well pumps. Plans and specifications were prepared by L. G. Knapp & Company, of Kansas City, Mo.

BILLINGS, MONT.—Application has been made to the City Council for a street railway franchise by the Eastern Montana Electric Railway Company and John A. Connolly. The granting of the franchise will be submitted to a vote of the people.

GREAT FALLS, MONT.—The Northern Montana Telephone Company, recently organized, is reported to be contemplating the erection of telephone lines from Fort Benton in all directions in the northern part of the State. Dr. D. S. McKenzie and others are interested in the project.

ANSLEY, NEB.—At an election held June 6 the proposition to issue $12,000 in bonds, the proceeds to be used for the erection of an electric light plant and extensions to water works system, was carried.

DAVID CITY, NEB.—It is reported that bonds to the amount of $40,000 have been voted, the proceeds to be used for improvements to the water and lighting system.

EMERSON, NEB.—The Elk Valley Telephone Company has secured permission to issue capital stock to the amount of $7,500. Plans have been prepared by the company for extensions and improvements to its system.

FAIRBURY, NEB.—It is reported that the city has decided to purchase the local electric light plant or construct a new one, for which bonds to the amount of $20,000 will be issued.

BEVERLY, N. J.—The contract for lighting the City of Beverly is reported to have been awarded to Mitchell B. Perkins, receiver of the Cinnaminson Electric Light Company, of Riverside, N. J., for $3,200 per year.

MOUNT HOLLY, N. J.—Representatives of the holders of $476,000 in bond of the Burlington County Railway Company on June 16 purchased the railway and holdings for $120,000. The company has 16 miles of track between Moorestown, Mount Holly and Burlington, N. J.

NEW BRUNSWICK, N. J.—The Common Council is considering the question of installing a municipal electric light plant. Under the present plans it is proposed to install a distributing plant and purchase electricity for same.

LAS CRUCES, N. M.—A franchise has been granted to Samuel T. Reynolds and Isidore Armijo for the construction and operation of an electric railway through the streets of Las Cruces. The proposed railway will extend from Las Cruces to Messilla Park. Under the terms of the franchise work must commence on construction of the railway within 90 days from the time it is granted.

LAS VEGAS, N. M.—We are informed that bids will soon be asked by the Rio La Casa Power Company for construction of its proposed power plant, to cost about $100,000. W. G. Benjamin is secretary of the company, and John L. Zimmerman, of East Las Vegas, N. M., consulting engineer.

ROSWELL, N. M.—It is reported that Otis & Hough, of Denver, Col., have purchased the plant and holdings of the Roswell Electric Light Company. The consideration is said to be $175,000. The new company, it is said, proposes to establish an electric railway system in Roswell, which will extend to its irrigation projects in this section.

BOLIVAR, N. Y.—Application has been made to the Public Service Commission, Second District, by the Southwestern New York Traction Company for permission to construct an electric railway from Bolivar to Wellsville, a distance of 18 miles. The company is capitalized at $200,000 and proposes to ask for authority to issue bonds to the amount of $300,000. Charles Van Curen, George H. Bradley, and others, of Bolivar, N. Y., are interested in the project.

ELMIRA, N. Y.—The Field Force Pump Company, of Elmira, N. Y., is reported to be erecting a new building, 75 ft. x 110 ft., to be used as a wood-working, painting and shipping department. Power machinery, including generators and electric motors, will be installed.

EPHRATAH, N. Y.—The Fulton County Gas & Electric Company, of Gloversville, N. Y., has been authorized by the Public Service Commision, Second District, to acquire from the Mohawk Hydroelectric Company the franchise granted in May, 1910, in Ephratah, and is also authorized to construct and operate an electric light plant in this town.

EPHRATAH, N. Y.—The Mohawk Hydro-Electric Company has applied to the Public Service Commission, Second District, for permission to exercise the franchises granted by the Town Board and Superintendent of Highways of the Town of Ephratah, and for authority to issue capital stock to the amount of $675,000, to execute a mortgage for $3,000,000 and also to issue $1,000,000 in bonds to be secured by the mortgage.

FORT SLOCUM, N. Y.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Slocum, N. Y., until June 25, for rewiring electric lighting pole line, furnishing and installing electrical apparatus for substation and construction of building for substation, for which plans and specifications and blank proposals may be obtained at the above office. Captain Peter Murray is quartermaster.

HAMBURG, N. Y.—The Howard A. Pierce Electric Light Company has been granted permission by the Public Service Commission, Second District, to issue capital stock to the amount of $12,500, the proceeds to be used to purchase the interest of Howard A. Pierce, Elizabeth Pierce and Laura S. Frank in the electric light plant in Hamburg. The company has also been given authority to transfer of the works, system and franchises of the Howard A. Pierce Electric Light Company for a water power plant at Water Valley, and the transmission line from Water Valley to the village of Hamburg, and the distribution system owned and operated by Elizabeth Pierce, Howard A. Pierce and Laura S. Frank.

LITTLE VALLEY, N. Y.—The Cattaraugus Cutlery Company, of Little Valley, N. Y., is reported to be increasing its electrical equipment.

LOWVILLE, N. Y.—The stockholders of the Black River Telephone Company have voted to increase the capital stock of the company from $50,000 to $200,000. S. C. Ormsby is secretary of the company.

MOGOLLON, N. Y.—It is reported that the Westinghouse, Church, Kerr Company will install a hydroelectric power plant on the Frisco River, near Mogollon. The company has secured options on a large amount of property in and about Alma.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until June 27 for repairs, alterations and additions to the electric equipment in Public Schools 106, 108, 16, 58 and 75, Borough of Brooklyn; for repairs, alterations and additions to the electric equipment in Public Schools 1 and 2, Borough of the Bronx, and Public Schools 103 and 157, 20, 40, 42, 79 and 147, in Borough of Manhattan.

NEW YORK, N. Y.—The Public Service Commission, First District, has granted the Third Avenue Bridge Company a certificate of necessity for an electric railway over Queensboro Bridge to Jackson Avenue, Long Island City. The proposed railway will connect with the Third Avenue system at East Fifty-ninth and East Sixtieth streets. The commission also adopted orders approving the contract between the new company and Frederick W. Whitredge, receiver of the Third Avenue Railroad system, and granted approval for exercise of the franchise of the new company. Judge Lacombe, in the U. S. Circuit Court, also authorized the receiver to transfer the Third Avenue Railroad Company's contract with the new company to the purchasers of the Third Avenue Railroad system.

RICHFIELD SPRINGS, N. Y.—The Public Service Commision, Second District, has decided to deny the application of the Hartwick Power Company for permission to erect and operate a distributing system in the village of Richfield Springs to furnish electricity for lamps, heat and motors, upon the condition that the Richfield Springs Electric Light & Power Company will make improvements and betterments to its plant in accordance with recommendations of the Commission, with a view of improving the service. The Commission will give the application of Hartwick Company further consideration if the Richfield Springs Company does not see fit to comply with the suggestions of the Commission.

ROME, N. Y.—Plans are being considered by the Rome Electrical Company, of Rome, N. Y., for the construction of a new factory, 80 ft. x 120 ft., and a power house, 32 ft. x 42 ft. George A. Clyde is general manager.

SPENCER, N. Y.—The Public Service Commission, Second District, has authorized Mary E. Seeley and Charles A. Seeley to maintain and operate an electric light plant in the villages of Spencer and Candor.

SYRACUSE, N. Y.—The Syracuse Lighting Company will soon apply to the City Council for permission to erect and maintain ornamental poles for cluster lamps in South Warren Street, Syracuse. The cost of maintaining the lamps will be paid by the business men in the section where the lamps are erected. Plans are also on foot for erecting ornamental lamps on Jefferson Street, between Warren and South Salina streets, in the near future.

TOMKINS COVE, N. Y.—The Tomkins Cove Stone Company is contemplating the installation of an 8-in., motor-driven, centrifugal pump.

CHARLOTTE, N. C.—Application has been made to the Board of Aldermen by Paul Chatham and associates for a franchise to construct and operate an electric railway on certain streets and into the suburbs of Charlotte.

GLEN ALPINE, N. C.—It is reported that J. D. Pitts, of Glen Alpine, N. C., and A. M. Kistler, of Morgantown, N. C., are interested in a project to develop water power on the Catawba River, near Glen Alpine, where it is estimated that 1800 hp can be developed, which will be transmitted to Morgantown and nearby towns and cities.

HICKORY, N. C.—The Ivey Cotton Mills have been equipped for electric motor drive. Electricity for operating the mills will be supplied by the Southern Power Company.

LEXINGTON, N. C.—Preparations are being made for equipping the municipal electric plant to utilize electricity furnished by the Southern Power Company, of Charlotte, N. C. The apparatus is being installed by Tucker and Laxton, of Charlotte, N. C. It is expected to have the system ready for operation by July 1.

RALEIGH, N. C.—The Raleigh Telephone Company has placed a contract for a switchboard, to be equipped with the "Wynne instantaneous service," having an ultimate capacity of 3000 subscribers. W. A. Wynne is manager.

SALISBURY, N. C.—Surveys have been made for the proposed railway which is to connect the Salisbury-Spencer Railway Company and the Piedmont Railway Company, both of which are under the same management.

WILLIAMSTON, N. C.—The city has voted to issue bonds to the amount of $10,000, the proceeds to be used for the construction of an electric light plant in Williamston, N. C.

FARGO, N. D.—At an election to be held July 6 the proposition to issue $35,000 in bonds for the construction of a municipal electric light plant will be submitted to a vote of the people.

GRAND FORKS, N. D.—The H. M. Bylessby & Company, of Chicago, Ill., is reported to have purchased the property of the Grand Forks Gas & Electric Company, of Grand Forks, N. D., the Red River Power Company and the Huott Power on the Red Lake River, above Crookston, Minn., the Marcus Johnson Power at Red Lake Falls, Minn., including the light plant. It is stated that $1,000,000 will be expended in improvements to the system.

AKRON, OHIO.—Arrangements are being made by the Firestone Tire & Rubber Company for installing additional equipment and equipping a large part of its machinery for electric motor drive. A contract has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for one 2000-kva, 480-volt, 60-cycle, three-phase, 1800 r.p.m., steam turbo-generator set, supplied with a type "C" condenser; one 50-kw, turbo driven exciter and a 55-kw motor generator; one 200-hp, two 300-hp and two 400-hp induction motors; one 300-kw synchronous motor generator set and 80-hp direct-current motors.

CADIZ, OHIO.—The Wheeling, Cadiz & Tuscarawas Traction Company has awarded a contract for the construction of its proposed railway from Wheeling, W. Va., to Uhrichsville, Ohio, a distance of 60½ miles. It is proposed to extend the railway to Newark, to connect Wheeling with Columbus, Ohio. E. Evans Townsend is president.

CINCINNATI, OHIO.—Contracts for equipment for the new power house for the University of Cincinnati amounting to nearly $150,000 were awarded June 16 as follows: For tunnels to Auderheide, for $22,000; power, piping and distribution to the Peck-Williamson Company, at $25,315; pipe covering to the Wirthlin-Scallen Company, for $2,774; electric wiring and distribution to Scanlan Electrical Company, for $9,537; hydraulic coal elevator to the National Elevator, $666.50; coal cars, tracks, etc., to Littleford Brothers, at $2,600.

NORTH BALTIMORE, OHIO.—The proposition to issue $20,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant, was carried at an election held June 14. J. W. Deter is city clerk.

PIONEER, OHIO.—At an election held recently the citizens are reported to have voted to issue bonds for the purpose of lighting the village by electricity. Energy for operating the system will be furnished from West Unity, 12 miles distant.

WILLOUGHBY, OHIO.—The capital stock of the Willoughby Telephone Company has been increased from $10,000 to $25,000.

ADA, OKLA.—J. E. Smith and others are reported to be interested in a project to construct a large power plant near Stonewall, Okla., at a cost of about $500,000. It is understood that a company will be organized.

OKLAHOMA CITY, OKLA.—Orders have been placed by H. M. Byllesby & Company, of Chicago, Ill., acting as engineers for the Oklahoma Gas & Electric Company, with the Allis-Chalmers Company, of Milwaukee, Wis., for a 36 and 68 x 48, heavy duty, cross-compound, condensing horizontal Corliss engine.

BEND, ORE.—Preparations are being made by the Bend Water, Light & Power Company for the installation of an electric light plant in Bend. A water wheel and generator have been ordered to be installed in connection with the new dam to furnish power temporarily. The local transmission system will be erected as soon as material can be obtained. L. T. Russell, electrical engineer, has been engaged to take charge of the work. Frank Robertson is at the head of the project.

GRANT'S PASS, ORE.—Announcement has been made by J. H. Beeman, of Gold Hill, that the Rogue River Water & Power Company will develop a water power this year at a cost of $100,000. The power plant will be erected on the property of the Gold Hill Canal Company.

KLAMATH FALLS, ORE.—C. S. and R. S. Moore, of Klamath Falls, Ore., have purchased the interests owned by Alexander Martin, Sr.; H. V. Gates and E. R. Reames, in the Klamath Light & Power Company, and have secured control of all the available power rights on Link River, the stream that drains Upper Klamath Lake. The Moore Brothers already own a valuable plant on the west side of the river which supplies electricity for lamps and motors in Bonanza, Midland and Merrill. The plant just purchased supplies electrical service in Klamath Falls, but is inadequate to meet the requirements made upon it, especially in the winter months. By combining the two plants it is expected that the service will be improved. The Moore Brothers also purchased the interests of the above-named parties in the Klamath Water & Light Company, which supplies this city with water.

PORTLAND, ORE.—The Mount Hood Railway & Power Company is constructing a power house at Bull Run. According to the present plans the water will be diverted across a peninsula from the Sandy River.

PORTLAND, ORE.—Arrangements are being made by the United Railways Company, of Portland, Ore., for the construction of a railway from Forest Grove to Tillamook, work on which will commence in the near future.

PORTLAND, ORE.—A contract has been awarded by the Portland Railway, Light & Power Company for the construction of a new dam to the Puget Sound Bridge & Dredge Company, work on which will begin in the near future. The dam is to be located about three miles below Cazadero.

REDMOND, ORE.—Arrangements are being made by the Crook County Light & Power Company to install an electric light plant in Redmond. For the present the plant will be driven by a gasoline engine. The plant will furnish electricity for both street and commercial lighting.

EAST HANOVER, R. F. D., GRANTVILLE, PA.—The capital stock of the East Hanover Telephone Company has been increased from $10,000 to $25,000. S. N. Ulrich, of Lebanon, Pa., is secretary.

ETNA, PA.—The Borough Council has decided to call a special election July 26 to vote on the proposition to issue $35,000 in bonds, the

proceeds to be used for the construction of a new electric light and water plant to replace the one destroyed by fire Dec. 24, 1909.

NEWMANSTOWN, PA.—The Newmanstown Electric Light Company is reported to be contemplating extending its system for the purpose of furnishing electrical service in Sheridan and Schaefferstown, Pa. A site has been purchased for a power plant. It is stated that orders have been placed for a 90-kw, 2200-volt, three-phase alternator, a 150-hp, Erie City engine and a tubular boiler. D. S. Martin, of Bellevue, Pa., is electrical contractor.

PHILADELPHIA, PA.—It is reported that all trains of the Lehigh Valley Railroad Company are to be equipped with new telephone apparatus, by means of which communication can be established with trains on any point on the road.

PITTSBURGH, PA.—Announcement has been made that the Fairmont & Pittsburgh Railway Company, recently incorporated, is making preparations to enter Pittsburgh from the coal fields of West Virginia. The company recently took over the Waynesburg & Monongahela Street Railway Company, which operates an electric railway in Waynesburg, Marianna and Carmichael, on the Monongahela River. Another railway has been secured by the company, extending from Morgantown, W. Va., to Blacksville, and also another railway branching out from Fairmont to Mannington, W. Va., and thence north and east to Blacksville, while a direct line passes through Blacksville on the state line of Pennsylvania and West Virginia, and continues through Greene and Washington Counties to Pittsburgh.

PITTSTON, PA.—The Bell Telephone Company has taken over the systems of the Newry Telephone Company, the Popular Run Company and the Blair Township Company, independent systems, in the vicinity of Hollidaysburg.

WAYNESBORO, PA.—Preparations are being made by the Chambersboro, Greencastle & Waynesboro Street Railway Company for the construction of a substation at Pen Mar, Pa. A 500-kw, Allis-Chalmers turbine is being installed at its power house in Waynesboro.

WAYNESBORO, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has recently ordered a six-inch, motor-driven, centrifugal pump of the Allis-Chalmers Company, of Milwaukee, Wis. The street railway company recently purchased a steam turbine and auxiliary apparatus from the Allis-Chalmers Company.

WEST CHESTER, PA.—The City Council is reported to be considering an ordinance calling for the construction of a subway, in which all electric wires, including telegraph and telephone, will be placed.

BARNWELL, S. C.—The question of calling an election to vote on the proposition to issue $16,000 in bonds, the proceeds to be used for construction of an electric light plant and water works, is reported to be under consideration.

McCOLL, S. C.—The McColl Cotton Mills are reported to be contemplating the erection of transmission lines in McColl to supply electricity for lamps.

ROCK HILL, S. C.—The Board of Public Works has engaged Benjamin Parks Rucker, of Charlotte, N. C., consulting engineer, to prepare plans and specifications for a municipal electric light plant. The city recently voted to issue $285,000 in bonds, of which the proceeds of $35,000 will be used for a municipal electric plant. John T. Roddey is Mayor.

PIERRE, S. D.—The Dakota Central Telephone Company has awarded the contract for the construction of its telephone exchange building to Albert Anderson. The building will be of reinforced concrete and will cost about $11,000.

KNOXVILLE, TENN.—The Allis-Chalmers Company, of Milwaukee, Wis., has been awarded a contract by the Knoxville Railway & Light Company for a 3000-kw, 2300-volt, 60-cycle, three-phase, steam turbo-alternator. Ford, Bacon and Davis, of New York, N. Y., are engineers in charge of the work.

AUSTIN, TEX.—The Trustees of the University of Texas are contemplating the installation of water tube boilers with a rating of 600 hp, and mechanical stokers in the new power house, recently completed, at the university.

COLEMAN, TEX.—At an election held June 11 the proposition to issue $20,000, the proceeds to be used for the construction of an electric light plant was carried. As yet an engineer has not been engaged. J. A. B. Miller is Mayor.

CORPUS CHRISTI, TEX.—The Corpus Christi Street Railway Company, which recently completed and has in operation an electric street railway system in this city, proposes to erect its own power plant. At present the company is purchasing energy from the local electric plant. The company will also furnish electricity for lamps and motors for private consumers in Corpus Christi.

DALLAS, TEX.—Property owners along the proposed route of the Terrell-Dallas Interurban Railway have subscribed to $15,000 of the company's stock and have donated the right of way. It is also proposed to donate a liberal bonus in aid of the project.

FALFURRIAS, TEX.—The Falfurrias Power Company is constructing a new electric light and power plant in Falfurrias.

FORT CROCKETT, GALVESTON, TEX.—The contract for the installation of an electric lighting system at Fort Crockett, Tex., has been awarded to the F. E. Newberry Electric Company, Century Building, St. Louis, Mo., for $11,943. Max Levy, of Galveston, Tex., secured the contract for electric wiring and fixtures for $4,298. Captain P. Whitworth is constructing quartermaster.

FORT WORTH, TEX.—An ordinance will soon be presented to the City Council requiring all electric wires to be placed underground. If the ordinance applies to the entire city the cost will be about $2,000,000, and $750,000 if applied to the fire districts only.

GALVESTON, TEX.—The Brush Electric Light & Power Company is enlarging its power plant to meet the increasing demand made upon it. A contract has been placed with the Allis-Chalmers Company, of Milwaukee, Wis., for one 937-kva, 2300-volt, 60-cycle, two-phase, 3600 r.p.m., steam turbo-generator set. A large part of the energy supplied by the additional unit will be used by the Great Western Dredging Company.

HOUSTON, TEX.—The Houston Electric Company has applied to the County Commissioners for a franchise to construct and operate an extension of its system from the city limits of Houston to Westmoreland Farms. The proposed extension will be about two miles in length and will cost about $75,000.

HOUSTON, TEX.—Preliminary arrangements have been completed by the Houston Bay Shore Traction Company for the construction of its proposed electric railway to connect Houston, Harrisburg and La Porte, Tex., 25 miles in length. Work will soon commence on construction of the road. A. Foster Irwin, of Houston, Tex., is president.

HOUSTON, TEX.—The Houston Light, Heat & Power Company, through its engineers, Ford, Bacon and Davis, has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for one 3000-kw, 2300-volt, 60-cycle, three-phase, 1800-r.p.m., steam turbo-generator set. The equipment will be installed during the summer to prepare for the peak load next winter.

MARBLE FALLS, TEX.—Owing to the scarcity of labor the construction of the large dam across the Colorado River and the installation of a hydroelectric plant at Marble Falls, by C. H. Alexander, of Dallas, and associates, has been delayed. It is hoped to have the work finished by the middle of September. In addition to supplying electricity in Marble Falls, transmission lines will be erected to a number of towns in this section. Mr. Alexander and associates are also interested in the construction of a large cotton mill in Marble Falls.

MEXIA, TEX.—It is reported that application has been made to the City Council for a franchise to construct and operate an electric light plant and water works in Mexia.

STAMFORD, TEX.—The Albany Telephone Company, which has toll lines from Moran to Rotan, and local exchanges at Albany, Stamford and Rotan, has been purchased by the Southwestern Telegraph & Telephone Company. The Southwestern Company, it is said, will make extensive extensions to the local service at once, and will immediately commence the erection of a telephone line from Stamford to Wichita Falls, from Stamford to Spur and from Stamford to Hamilton, and will rebuild the line from Stamford to Moran. J. S. T. Yeager is local manager.

WACO, TEX.—Preparations are being made by the Waco Gas & Electric Light Company for doubling the capacity of its plant, which will involve an expenditure of $25,000 and include improvements to both electric and gas systems.

LOGAN, UTAH.—The Trustees of the Utah Agriculture College at Logan have decided to take immediate action on the construction of a power plant for the college. It is understood that bids for construction of equipment of the plant will be called for at once. Specifications will provide for the completion of the work by the time the college opens next fall. The college owns water rights on the Logan River between the present plant of the Telluride Power Company and the irrigation intakes, which will develop more power than will be required by the college at present.

GRAHAM, VA.—The Graham Electric Railway Company is reported to be considering the question of purchasing equipment for electric railway and electric light plant, including rails and motor cars. James F. Dudley is president.

IONE, WASH.—The Panhandle Lumber Company is erecting a large timber cutting plant at Ione, Wash., with machine shop, which is equipped for electrical operation throughout. Power for operating the plant is furnished by two 1000-hp turbines, driving alternating-current generators. Electric locomotives will be used for transferring material about the plant, for which over 25 miles of railway track will be required.

PORT TOWNSEND, WASH.—The Olympic Power & Transmission Company, recently incorporated with a capital stock of $1,000,000, has completed plans for the construction of a transmission line from the Elwah River to Port Townsend. The initial development will be 5000 hp. George A. Gaines, of Winnipeg, and Thomas J. Aldwell, of Port Angeles, Wash., are interested in the project.

SEATTLE, WASH.—The City Council has passed an ordinance providing for the installation of a system of cluster lamps on Stewart Street from First Avenue to Westlake Avenue; Virginia Street from the alley between Third Avenue and Fourth Avenue; Fourth Avenue from Pine Street to Virginia Street; Fifth Avenue and Sixth Avenue, each from Westlake Avenue to Virginia Street, in accordance with plans prepared by the city engineer.

TACOMA, WASH.—Orders have been placed by the Manley Moore Lumber Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 150-kva, 240-volt, three-phase, 60-cycle alternator, together with an exciter and switchboard. The new equipment will furnish electricity for driving some of the mill machinery and for lamps about the plant.

PETERSBURG, W. VA.—The citizens are reported to be considering the question of constructing an electric light plant and water works system.

MANITOWOC, WIS.—The C. Reiss Coal Company, of Sheybogan, Wis., is planning to rebuild its docks at Manitowoc, Wis., and install new electrically operated handling machinery, provided the city makes the necessary improvements to permit better access to the property by vessels.

MERRILL, WIS.—The Merrill Railway & Lighting Company is reported to be contemplating improvements to its service in the near future, which will involve an expenditure of about $5,000.

MILWAUKEE, WIS.—Plans are being prepared by the Milwaukee Electric Railway & Light Company for the construction of an addition to its power house, increasing the output from 20,000 hp to 80,000 hp. Three steam turbines, with a rating of 20,000 hp each, will be installed.

MONROE, WIS.—Arrangements are being made by the Dodge Lumber Company, of Monroe, Wis., for the installation of motor-driven elevating machinery and an automatic shovel in its fuel yards.

RACINE, WIS.—Plans are being made by the Racine Gas Engine Company for the erection of a new factory building, for which a generator and motors will be required.

RACINE, WIS.—The purchase of a gas producer plant, gas engine, with a rating of from 150 to 200 hp, generator and a small line of motors is under consideration by the Hilker-Weichers Manufacturing Company to be installed in its factory now being erected in Racine.

WEST ALLIS, WIS.—The Wisconsin Motor Manufacturing Company is reported to have purchased a site in West Allis, Wis., on which it will erect a large plant for the manufacture of automobiles. The main building will be 115 ft. x 290 ft., with a separate power house 50 ft. x 50 ft. Charles F. John is president of the company.

CALGARY, ALTA., CAN.—It is reported that bids are being asked for the construction of a conduit system for telephone lines in Calgary. Smith, Kerry & Chace, Bank of B. N. A. Building, Calgary, are engineers.

MEDICINE HAT, ALTA., CAN.—H. A. Maxwell is reported to have submitted a report on the installation of a municipal electric light and power plant in Medicine Hat, to cost about $50,000.

NEW MICHEL, B. C., CAN.—It is reported that Broley & Martin, contractors in charge of construction of the new municipal water works system, are negotiating with the New Michel Sawmill Company to install an electric lighting system.

BRANDON, MAN., CAN.—It is reported that plans have been prepared by City Engineer Speakman for the installation of a new street lighting system.

DAUPHIN, MAN., CAN.—At an election held recently the by-law to appropriate $11,000 for electric lighting was carried.

WINNIPEG, MAN., CAN.—The City Council is reported to have decided to purchase a site on King street, a short distance from Notre Dame, on which it will erect a sub-distributing power station.

WINNIPEG, MAN., CAN.—The contract for the construction of the McPhillips Street substation has been awarded to J. W. Astley, of Winnipeg, Man., for $11,423. G. M. Gest, of Montreal, Can., secured the contract for construction of conduits, which is not to exceed $40,000.

HAMILTON, ONT., CAN.—The City Council has approved of a portion of the route of the transmission line of the Hydro-Electric Power Commission in Hamilton.

OTTAWA, ONT., CAN.—It is reported that surveys are being made by the Metropolitan Electric Company of its property at the Deschenes Rapids, in Village of Britannia, six miles distant. It is said that work on the construction of a plant for the development of power will commence in the near future.

PETERBOROUGH, ONT., CAN.—The Peterborough Light & Power Company is reported to have purchased the dam at Auburn. It is said that the company proposes to erect a new dam and power house above the present dam at a cost of about $125,000. J. H. Larmonth is manager.

WESTON, ONT., CAN.—The town of Weston is reported to have agreed to accept the offer of the Hydro-Electric Power Commission to supply power from Niagara Falls.

LONGUEUIL, QUE., CAN.—The Corporation of Longueuil is reported to have decided to authorize $35,000 for municipal improvements, including the installation of a municipal electric light plant and an electric pumping station in connection with the water-works system to cost $24,000.

QUEBEC, QUE., CAN.—It is reported that the Deschambault Electric Company is contemplating the construction of a concrete dam on the River St. Anne, at St. Alban, bids for which have been received. J. F. Guay is consulting engineer.

CULIACAN, SINALOA, MEX.—If negotiations now pending for the sale of the San Fernando Mines, in the Juarez district, State of Durango, to a syndicate of Americans, headed by John T. Canfield, of Culiacan, is consummated, it is reported, that the hydroelectric power plant that was erected on the Haymaya River and the electric railway, 10 miles in length, constructed at the mines by the San Fernando Mining Company, several years ago, at a cost of about $1,500,000, will be rehabilitated and placed in operation.

LA BOQUILLA, CHIHUAHUA, MEX.—S. Pearson & Son., Ltd., with headquarters in Mexico City, who have the contract for the construction of the large dam across the Conchos River, at this place, for the Compañia Agricola de Fuerza Electrica del Rio Conchos, is establishing the Town of La Boquilla for the accommodation of the men who will be employed in the construction of the dam. The company is now constructing a temporary power station, which will be equipped with two 500-kw generators. Three cableways, each of more than 1000-ft. span, are being installed for use in moving material to the site of the dam. These cables will be driven by electricity. The Compañia Agricola de Fuerza Electrica del Conchos is a subsidiary of the Mexican Northern Power Company.

PEARSON, MEX.—The Mexico Northwestern Railway Company, which has extensive railway and lumber interests in the northwestern part of the country, is making additions to its power plant in Pearson, for which orders for equipment have been placed with the Allis-Chalmers Company, of Milwaukee, Wis. The contract calls for a complete generating plant, including three 1000-kw, 600-volt, three-phase, 60-cycle, 3600-r.p.m., steam turbo-generator sets, supplied with type "C" condensers. A 45-kw motor-generator set will ordinarily supply exciting current, but for starting purposes a 50-kw, turbine-driven exciter will be installed. A 14-panel switchboard with necessary controlling instruments is included. Electricity generated at the plant will be used for lamps and motors about the lumber mill and yards, and also for lighting and manufacturing purposes in Pearson.

SAN SEBASTIAN, JALISCO, MEX.—Orders have been placed by the Tajo Mining Company for equipment for a hydroelectric plant to be installed at its mines, near San Sebastian, for the purpose of furnishing electricity to operate its reduction mill and other machinery.

SAYULA, JALISCO, MEX.—It is reported that plans are being prepared by Jefe Pelitico Consalex Rubio for the construction of an electric light plant. The proposed plant will be driven by a producer-gas engine.

New Industrial Companies.

THE BAIRD ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 by E. P. Baird, George C. Bent and J. A. Campbell. The company proposes to manufacture and deal in electrical machinery and apparatus.

THE BARBER GRAPHITE COMPANY, of Glens Falls, N. Y., has been incorporated by Frank W. Wait, Charles W. Hitchcock and George W. Little, of Glens Falls, N. Y. The company proposes to manufacture and deal in graphite and carbon of all kinds.

Personal.

MR. JOHN S. PARMALEE has been appointed assistant manager of the Lord Manufacturing Company, New York.

MR. T. TOWNSEND SMITH, fellow in physics in Harvard University, has been appointed instructor in physics at the University of Kansas.

PROF. HATSUNE NAKANO, of the department of electrical engineering of the University of Tokyo, Japan, is visiting this country.

MR. J. W. MINOR has been appointed as inspector in the electrical department of Denver, Col., to take the place of A. M. Wion, resigned.

DR. WILLIAM A. GRANVILLE, of the Sheffield Scientific School of Yale University, has been appointed president of Gettysburg University.

MR. HOWARD H. AGEE, of the class of 1910 of the Pennsylvania State College, has been appointed instructor in electrical engineering at the Massachusetts Institute of Technology.

MR. F. D. WHEELER, formerly engineer for the Semet-Solway Company, Syracuse, N. Y., has joined the staff of the department of examinations and reports of H. M. Byllesby & Company, Chicago.

DR. EDWARD WESTON has received from Princeton University the honorary degree of Doctor of Science. Several years ago the same degree was conferred on Dr. Weston by the Stevens Institute.

MR. W. E. HARKNESS, who was identified for several years with the Western Electric Company in the development of telephone train despatching, has become associated with the United States Electric Company, New York.

MR. GEORGE J. KIRCHGASSER has resigned his position as electrical inspector for the Buffalo Association of Fire Underwriters and has accepted a position with the Cutler-Hammer Manufacturing Company, of Milwaukee.

M. FREDERIC LAPORTE, assistant director of the Laboratoire Central d'Electricité, at Paris, returned last week to France upon the completion of his work at the National Bureau of Standards in relation to international standardization.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Company, sails for Europe on the *Carmania,* on Saturday, June 25, for his annual visit to the manufacturing centers of Europe. Mr. Hirschberg expects to return about the middle of August.

MR. C. E. ARMSTRONG, formerly general superintendent of the Cairo Railway and Light System, Cairo, Ill., recently severed his connections with this company and is now located in Peoria with Maddox & Armstrong, engineers and manufacturers' agents.

SIR HENRY PELLATT, president, and Mr. H. H. Macrae, general manager of the Toronto Electric Light Company, Limited, recently accompanied the members of the sales department to Niagara Falls, Ont., where the plant of the Electrical Development Company was visited.

MR. W. B. McDONALD, formerly manager of the Idaho Falls, Mont., Electric Company, has been appointed manager of the Flathead Valley Water Power Company, Kalispel, Mont., succeeding Mr. O. A. Farrar, who goes to the Portland, Ore., branch office of H. M. Byllesby & Company.

MR. ISHAM RANDOLPH, hydraulic engineer of Chicago, and consulting engineer for the Sanitary District of Chicago, received the honorary degree of doctor of engineering from the University of Illinois, June 15. In the undergraduate engineering courses 187 degrees were also granted.

MR. WILLIAM C. GOTSHALL, consulting electrical engineer, New York, was painfully, though not seriously, injured as the result of an automobile accident on June 15 when a motor car, in which were he, Mrs. Gotschall and their guest, Miss Scherp, of Berlin, collided with an automobile dray at Hopenkammer, Bavaria.

PROF. L. P. BRECKENRIDGE, of the department of mechanical engineering at Sheffield Scientific School, Yale University, received the honorary degree of doctor of engineering at the recent commencement at the University of Illinois. Professor Breckenridge formerly held a corresponding position at the latter university and was highly esteemed by the faculty and the students.

MR. KEMPSTER B. MILLER, of Chicago, recently submitted a report to the city of Oakland, Cal., on the gas and electric light situation there, the result of an investigation for which he was engaged by the municipality. Among the recommendations are a change from 440-volts, three-wire, to 220-volts two-wire, with grounded neutral, the replacement of street-lighting carbon incandescents by tungstens, and the disuse of gas mantles for street lighting.

MR. WILBUR B. FOSHAY, recently manager of the Kansas Gas & Electric Company, has joined the staff of the Columbia Power & Light Company, of Walla Walla, Wash. Upon his departure from Wichita, "The Peerless Prophets," a civic organization of that city highly commended in a resolution Mr. Foshay's co-operation in the success of the annual jubilee celebration, and for the public-spirited manner in which he has conducted the gas and electrical properties in his charge.

MR. THOMAS H. FERGUSON, who served for about three years as patent attorney for the General Electric Company, and later in the same capacity for the Kellogg Switchboard & Supply Company, has opened offices in Chicago for the practice of patent law. Mr. Ferguson is a graduate of the University of Michigan in literature and engineering, and of the Detroit College of Law, and Columbian University, in law, and for about four years was an examiner in the United States Patent Office, in different mechanical and electrical divisions.

MR. J. J. DAWES, formerly with the American Light & Traction Company, American Gas & Electric Company, H. L. Doherty & Company, and at present with Young & Warner, of Corning, N. Y., has accepted a position as contract agent for the Blackstone Valley Gas & Electric Company. This company, which is managed by the Stone & Webster Management Association, is holding company for the Pawtucket Gas & Electric Company, the Woonsocket Gas & Electric Company and other adjacent properties in the Blackstone Valley. Mr. Dawes will take up his new work on July 15.

MR. H. F. PARSHALL, now of London, England, but formerly an electrical engineer of this country, has been given the degree of Doctor of Science by Tufts College. Mr. Parshall is a graduate of Lehigh University, which conferred upon him the honorary degree of Master of Science in 1908. He served as designing engineer for the Sprague Electric Railway & Motor Company, the Edison General Electric Company, and the General Electric Company. Since 1897 he has resided in London, but in 1904 he lectured on the design of electrical machinery at the Massachusetts Institute of Technology. He has contributed liberally to the engineering societies and technical press on subjects relating to electric machine design and railway problems, and is the author of four books on these subjects.

Obituary.

MR. CHARLES TRIPPE, superintendent of the New York office of the Anglo-American Telegraph Company, died on June 16 at his home in Brooklyn. He was one of the expert telegraphers on board the *Great Eastern* when the first successful Atlantic cable was laid in 1866. Mr. Trippe was born in England sixty-seven years ago. He had charge of the first cable station established in America, at Heart's Ease, Newfoundland. In 1887 he was transferred to the station at St. Pierre, Island of Miquelon. He was again at Heart's Ease from 1894 to 1897, and then became superintendent at New York City. He is survived by three daughters and two sons.

BUSINESS NOTES.

THE BURNET COMPANY.—Mr. James Jones, Jr., for many years in the electrical supply business, has joined forces with The Burnet Company, 69 South Street, New York.

THE DETROIT FUSE & MFG. COMPANY has opened a Chicago agency with the Continental Electric Company, 221 South Clinton Street. Complete stock of "Arkless" fuses and "Detroit" switches will be carried for the convenience of the Chicago trade.

NEW ENGLAND "EXCELLO" BRANCH.—Mr. A. E. Payne, for the past eight years sales engineer for Stuart-Howland Company, Boston, has severed his connections with that firm and taken the management of the New England branch for the Excello Arc Lamp Company, established at 184 Franklin Street, that city. Mr. Payne had charge of the "Excello" sales for the former agents in that territory, and is thus thoroughly capable of handling the business from the start.

NERNST LAMPS.—Among the recent orders received by the Nernst Lamp Company were four from the wholesale establishment of Marshall Field & Company, Chicago, aggregating 888 glower units. All of the lamps are of the multiple glower type, and special finished housings are used. This firm installed its first Nernst lamps in December, 1907, the same year of the installation of 12,000 glower units in the retail store of Marshall Field & Company, and has frequently since placed orders for Nernst lamps to replace other lamps. An order was received from the Banks Business College, of Philadelphia, for an installation of Westinghouse-Nernst lamps for the illumination of its new quarters. Single glower lamps, multiple glower lamps, and chandeliers will be used.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 14, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

961,103. ELECTRICALLY HEATED TOOL; W. G. Clark, New York, N. Y. App. filed June 28, 1909. Improvements in electrically heated tools or soldering irons, the heating unit being a glowing filament contained within the chamber in the tool.

961,124. ELECTROLYTIC APPARATUS WITH ANNULAR ANODE; H. Hatfield, Jena, Germany. App. filed March 7, 1910. For restraining the agitation of the anode by shocks, the restraining body being a protective wall projecting above the surface of the anode.

961,125. ELECTROLYTIC APPARATUS; H. Hatfield, Jena, Germany. App. filed March 7, 1910. Apparatus with annular anode to prevent the liquid anode from being jerked out of the vessel into the cathode. The anode is divided into partial anodes by a screen.

961,139. ELECTRICAL CONDUCTOR; C. A. Keller, Paris, France. App. filed July 13, 1908. For electrodes of electric furnaces, the electrode having an opening and being connected to an electrical conductor having a hollow portion adapted for insertion into the opening and having an aperture extending from the hollow portion outwardly to the sides of the conductor and a fusible element in the aperture.

961,142. METER-PANEL; H. Krantz, New York, N. Y. App. filed July 28, 1909. A meter, a panel board comprising a base, busbars and crossbars, branch circuits and a supply circuit and meter bars with a movable selective contact device.

961,145. THERMO-ELECTRIC REGULATOR; W. E. Mack, Fort Plain, N. Y. App. filed Feb. 12, 1908. For setting the terminals to control the action of the damper-operating mechanism, which operates electrically to open the draft damper and close the check damper.

961,146. PORTABLE TELEPHONE AND TESTING INSTRUMENT; N. Macking, Wilkes-Barre, Pa. App. filed Feb. 5, 1910. A source of direct current, a visual and audible signal responsive to direct current and a reversing switch for coupling the source of current in either direction to the line.

961,157. TELEPHONE ATTACHMENT; J. A. Perry, Bidwell, Ia. App. filed Nov. 19, 1909. For permitting a number of users to listen at the receiver at one time by means of a sound chamber with which a plurality of tubes and ear pieces are connected and into the mouth of which a telephone receiver projects.

961,164. CIRCUIT-CONTROLLER. E. Rothwell, Manchester, Eng. App. filed June 25, 1907. Electric railway of the surface contact system in which the rail is divided into sections, each having a circuit controller normally open and having a switch actuated by a

shunt coil to close the main circuit between the distributor and the rail section when a car traveling in either direction arrives on said section.

961,167. APPARATUS FOR TREATING LIQUORS; J. Seitz, Chicago, Ill. App. filed Nov. 2, 1908. For aging liquors by means of a bung through which a plurality of sleeves project, one sleeve carrying an adjustable tube and insulated conductors being secured to the other sleeves.

961,175. ELECTRIC FUSE; A. J. Smith, New York, N. Y. App. filed June 15, 1909. Improved electric fuse having a fixed interior shell with an elongated opening, an exterior shell turnable thereon and provided with an opening registering with the opening of the fixed shell caps attached to opposite ends of the fixed shell and holders for the strip connected to the caps with conducting wires.

961,177. ELECTRICAL BLOCK TRAIN-CONTROL SYSTEM; J. B. Tonnar, Clayton, Wash. App. filed Dec. 11, 1908. Signal apparatus permitting communication between a block operator and the engineer on train.

961,185. CONTROLLER-SWITCH FOR ELECTRIC MOTORS; S. M. Ward, Jr., Washington, D. C. App. filed March 17, 1909. Starting-switch with an intermediate position and a quick-acting movable member on the handle, and a shoulder on the casing co-operating therewith, so that the handle must be thrown in one direction each time before it is thrown in the other direction.

961,242. ELECTRIC SWITCH; L. Larsen, New York, N. Y. App. filed Jan. 23, 1909. A base with an electromagnet, surrounded by a pivoted frame carrying a contact co-operating with a fixed contact on the base and a spring for holding the contacts closed.

961,265. APPARATUS FOR DETERMINING THE DIRECTION OF SPACE-TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed April 15, 1909. Two separated elevated receiving conductors, two receiving circuits, each associated with a different one of the conductors; two artificial lines, each connected with a different one of the circuits, and an oscillation detector connected with said lines.

961,268. ARC-LAMP ELECTRODE; G. A. Thomson, Somerville, N. J. App. filed Sept. 24, 1908. Metallic molybdenum mixed with metallic iron.

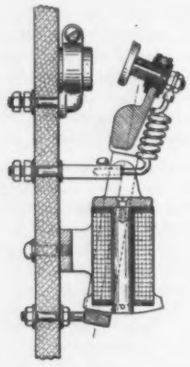
961,269. ARC-LAMP ELECTRODE; G. A. Thomson, Somerville, N. J. App. filed Sept. 24, 1908. Contains oxide of molybdenum giving a white arc.

961,298. PROSPECTOR'S NEEDLE; Dell W. Jewell, Kalamazoo, Mich. App. filed Jan. 12, 1910. For locating mines by means of a magnetic needle.

961,308. ELECTRIC CUT-OUT; Thomas E. Murray, New York, N. Y. App. filed April 1, 1910. Fuseholder, the fuse being reduced as to a portion and arranged in an opening in the standard with a cover secured to the base and enclosing it in the standard.

961,313. SYSTEM OF ELECTRICAL DISTRIBUTION; G. E. Palmer, Boston, Mass. App. filed Nov. 23, 1904. For systems of electrical distribution, particularly lighting system in which independent motors control lamp circuits and are selected and controlled independently of each other.

961,322. APPARATUS FOR EXAMINING MATTER OF OBJECTS IN QUANTITIES; J. I. Solomon, New York, N. Y. App. filed April 24, 1908. For examining pearls in pearl oysters by passing a radiographic beam of energy through the pearls on a support.



961,242—Electric Switch.

961,326. INCANDESCENT-LAMP BASE; T. G. Turner, New York, N. Y. App. filed Oct. 12, 1908. For rendering useless incandescent lamps when once removed from the socket, by destroying the connection between the terminal and the filament operable upon the removal of the lamp.

961,342. LIFTING-MAGNET CONTROLLER; A. C. Eastwood, Cleveland, Ohio. App. filed Jan. 28, 1909. For lifting magnets in which a magnetically closed switch and a master switch are used with contacts for closing the circuit of the winding to give a reversed direction of current through the winding.

961,353. POWER-DRIVEN MACHINERY; D. C. Jackson, Madison, Wis. App. filed Sept. 17, 1904. For adjusting the speed of a planer in one direction without affecting the speed in the other direction.

961,369. TELEPHONE TRANSMITTER DISINFECTOR; F. H. Peck, Galveston, Tex. App. filed Aug. 18, 1909. Mouthpieces for telephone transmitters with a detachable disinfecting cap for closing the opening, provided with a membrane saturated with a germicide.

961,411. VOLTAGE-REGULATOR; C. S. Johnson, Chicago, Ill. App. filed Oct. 20, 1904. Alternate-current electric system with means for controlling the voltage regulator by means of a rheostat and gears driven by the shafts of the converter and motor and an idle gear moving the arm of the rheostat and engaging the other gears.

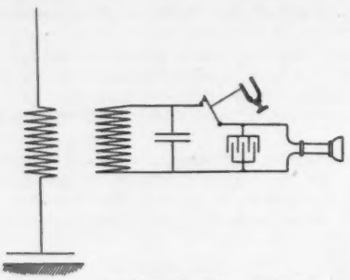
961,430. AERIAL ELECTRIC TRANSPORTATION; O. J. Davy, Washington, D. C. App. filed Oct. 2, 1906. For monorail systems by means of a conductor wire, a carrier on the track with contact engaging the wire, a pole changer on the carrier and weighted rods suspended from the track and having pins in pairs to impart successive movements to the pole changer in the same direction.

961,440. FIRE-ALARM BOX; T. Haines, St. Louis, Mo.—App. filed June 17, 1909. A telegraphic call mechanism and a detonating device arranged to be actuated by a part of the call so as to detect a person giving a false alarm.

961,468. APPARATUS FOR REMOVING THE GREASE AND YOLK FROM WOOL; R. Vandatte and Benoni Lagye, Antwerp, Belgium. App. filed Jan. 14, 1910. The wool passes through a vat through which an electric current flows.

961,475. BONDING-PIN; L. S. Bacon, Washington, D. C. App. filed Oct. 27, 1905. A bonding-pin with a plurality of longitudinal grooves and a transverse groove across one end and connecting the longitudinal grooves together.

961,514. PROCESS FOR TREATING ZINKIFEROUS SUBSTANCES; G. Mojana, Milan, Italy. App. filed Dec. 14, 1906. For treating zinkiferous substances by subjecting them to the action of chlorin in the presence of porous carbonaceous matter.



961,645—Receiver for Wireless Transmission of Signals.

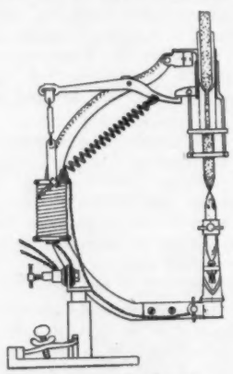
961,549. CATHODE; E. A. Sperry, Brooklyn, N. Y. App. filed Jan. 26, 1909. Metallic plate with longitudinal perforations arranged transversely to the longest connection of the plate.

961,600. ELECTRICAL SIGN RECEPTACLE; E. H. Freeman, Trenton, N. J. App. filed April 1, 1910. A receptacle with a plug, receiving socket and external seats, a center plug contact, a wire terminal, plate arranged in one of said seats with a screw connection to the center plug and a screw shell detachably fitted to the nut plates within the body.

961,605. ELECTRIC LAMP SOCKET; G. W. Goodridge, Bridgeport, Conn. App. filed Feb. 10, 1910. Double break key consisting of a spindle and cam acting to press two spring contacts into connection with the stationary contact.

961,607. X-RAY APPARATUS; A. Granger, New Orleans, La. App. filed Feb. 13, 1909. A frame for supporting X-ray apparatus so that it may be slid along and moved in front of the patient.

961,615. DAMPER OR DRAFT-CONTROLLING DEVICE; C. F. Johnson, Milwaukee, Wis. App. filed Nov. 25, 1908. The damper is actuated by the weight of the water, the feeding of the water to one of two receptacles being controlled by electromagnets, including a thermostat.



961,733—Arc Lamp.

961,645. RECEIVER FOR WIRELESS TRANSMISSION OF SIGNALS; Valdemar Poulsen, Copenhagen, Denmark. App. filed Oct. 22, 1907. An oscillation circuit, an electromagnetic apparatus and a device for intermittently connecting and disconnecting the device to and from the oscillation circuit.

961,646. INSULATOR; W. L. Reusch, Yorkton, Saskatchewan, Canada. App. filed April 24, 1909. An insulator comprising a base with a threaded upper end and a cross channel and enlarged at the bottom throughout its length and a longitudinal split tube adapted to pass snugly within the enlarged portion of the channel, with a cap bearing on the end of the tube.

961,681. GAS LIGHTER FOR AUTOMOBILE LAMPS; H. V. Cold, Monte Vista, Col. App. filed Sept. 25, 1908. Gas lighting for automobile lamps so that the driver may light them without leaving his seat, the burner having a tip with an ignition device and electrodes arranged on opposite sides of the burner.

961,693. ELECTRIC SWITCH; H. C. Grant, Bayonne, N. J. App. filed July 9, 1908. Rotary snap switch, the switch member being made of sheet metal. Details.

961,716. CARTRIDGE FUSE; A. F. Daum, Pittsburgh, Pa. App. filed March 6, 1910. A fuse cartridge with detachable end caps for new fuses.

961,720. SELF-CLOSING FLUSH RECEPTACLE PLATE; H. Hubbell, Bridgeport, Conn. App. filed Dec. 13, 1909. Cover plate for flush receptacles, the opening having a two-member self-closing hinged spring pressed cover with the usual hole for the neck of an attachment plug.

961,733. ARC LAMP. J. C. Piper, Indianapolis, Ind. App. filed June 10, 1907. Head-lamp for locomotives with means for controlling the upper electrode. Details.